



Government of Bengal

Working Plan for the  
Forests of the Sundarbans  
Division

For the period from  
1st April 1931 to  
31st March 1951

By

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Volume I

Parts I and II and Appendix I

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## INTRODUCTION.

**Resumé of the proposals.**—The previous management in this division confined the felling of *sundri* to one or two annual coupes; these fellings have been monopolised by woodcutters from the locality known as Barsakati in the district of Barisal. Permits for the extraction of most other types of produce have been issued from revenue stations on the borders of the forests, and the felling or cutting of this miscellaneous material has been unregulated and unsupervised. Briefly, the prescriptions now recommended divide this large tract of 2,473 square miles of forest into six range charges, and provide for a number of annual coupes, to which the extraction of all types of timber and fuel will be confined. The decentralisation into ranges will enable the administration of the division to become reasonably efficient, and will make possible the introduction of improvements in the forest management of this valuable property. The multiplicity of coupes will encourage the sale of *sundri* in local markets; the encouragement of local sales should, in its turn, slowly enlarge the extent of the *sundri* market farther afield, and end the monopoly of Barsakati for this timber. By confining the cutting of miscellaneous material to coupes, it will be possible to repair slowly the depredations of the unregulated fellings made in previous years, and to ensure a reasonable utilisation of the material in each tree felled. (See paragraphs 105 and 106 of Part I.) At the same time, by the introduction of an annual coupe for each type of produce between each pair of main rivers, the local woodcutters with small boats will experience no hardship by having to travel large distances for their produce. On the contrary, the woodcutter will have his produce found for him, instead of having to hunt about over the whole forests, trying to find trees which have escaped the notice of previous permit-holders. With more detailed supervision, it will also be possible to eliminate in most cases the irksome restrictions regarding the limitation of time on permits, and the imposition of time expiry fees, which were necessary under the old system of working these forests. Naturally, the new system of management will be more costly. For this reason, it has not been possible for me to recommend its introduction in the protected forests of the Alipore and Diamond Harbour subdivisions. The latter forests are mostly of very poor quality, and large tracts of them are likely to be colonised and cleared in future years. It is therefore proposed to work these forests, as before, on the revenue station and permit system with unregulated felling.

**The Preliminary Working Plan Report.**—The Preliminary Working Plan Report for the plan as detailed in this book was submitted by the writer in letter No. 107/4-2, dated the 26th March 1926, and was sanctioned by the Conservator in his No. 2822/1W-6, dated the 12th June 1926. The methods suggested in this report regarding the valuation, stock-mapping and the division of the western forests into compartments, have been followed—with one exception:—In the preliminary report, it was suggested that extra lines should be cut and surveyed in between the lines to be enumerated, purely for aid in stock-mapping. As the network of small *khals* in each compartment was found to be fairly accurately mapped, the addition of these extra lines to act as guides for the boundaries between the different types of forests was not found to help to a sufficient extent to justify the extra cost and labour required. After the first compartment had been enumerated and stock-mapped, these extra lines

were not cut. The proposals regarding the constitution of the different working circles have been departed from more widely. In all, nine working circles were proposed in the preliminary report; they may be compared roughly with the working circles finally recommended in the working plan as follows:—

Working circles suggested in the Preliminary Report.	Corresponding working circles proposed in the Working Plan.
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#### Forests of the Khulna district.

I—*Sundri* fresh-water.

\*II—*Sundri* salt-water.

\*III—Forests consisting mostly of small sized *gengwa*.

IV—The Khulna *Goran* Working Circle, superimposed on Working Circles I, II, and III

V—Boundary Working Circle to supply fuel, houseposts and *golpatta* for local needs.

I—Fresh-water Working Circle.

II.—Moderately Salt-water Working Circle, Felling Series 1 and 2.

II—Moderately Salt-water Working Circle, Felling Series 3 and 4.

IV—*Goran* Working Circle, Felling Series 1 to 5 inclusive.

The formation of this working circle was abandoned.

#### Forests of the 24-Parganas district.

VI—Forests east of the Matla river. (When the preliminary report was submitted, these forests were protected only, and not reserved.)

VII—Protected forests west of the Matla river.

VIII—The *Golpatta* Working Circle.

IX—Unregulated Working Circle (consisting of leased lands and areas earmarked for colonization).

III—Salt-water Working Circle, and Felling Series 6 and 7 of the *Goran* Working Circle, superimposed thereon.

V—Western Working Circle.

The scheme for *golpatta* has been given in the chapter on miscellaneous prescriptions instead.

It has been found more convenient to include the lands ear-marked for colonization in Working Circle V, and to treat the leased lands as areas outside the working circles. (See paragraph 147 of Part II.)

\*In writing the plan it was found that the main prescriptions of these two working circles would be the same, and that separate felling series were all that were needed.

With the exception of the fifth working circle suggested in the preliminary report, each working circle was to consist of only one felling series.

**Revision of the preliminary report and subsequent proposals.**—The proposals for the management of the forests in the Khulna district were revised in letter No. 487/5-110, dated the 30th July 1927. This letter stated that it was found that the proposal of the Boundary Working Circle would be expensive to carry out, and its success would be doubtful owing to the lack of exploitable material left near the boundaries. For the benefit of the owners of small boats, a number of felling series in each working circle were suggested instead. The forests in the Khulna district were to be divided into four ranges, and a definite estimate of the cost required to introduce and maintain the management recommended, was submitted. As the field-work of the plan progressed and more information became available, the proposals of this original

letter were revised and elaborated from time to time, and the proposed scheme for the forests of the 24-Parganas district were included in the estimate of the cost.

**Administrative approval by Government.**—Government gave administrative approval to the proposals in their letter No. 18529 For., dated the 7th November 1928, but money was not provided in the budget for its introduction until 1930-31, when a sum of Rs. 83,000 was sanctioned for the initial non-recurring expenditure, and Rs. 54,957 for the ultimate extra recurring expenditure. Unfortunately, after a sum of Rs. 26,227 had been spent, the sanction for starting the scheme had to be withdrawn, because of the extra funds required by Government for coping with the civil disobedience movement. At the same time, it was found that the estimate for the purchase of motor launches for the Range Officers, was based on the cost of unreliable craft. On the recommendation of the Chief Engineer and Ship Surveyor of Calcutta, this estimate was revised, and the estimate of the initial non-recurring expenditure required for the scheme was raised to Rs. 1,32,335, or Rs. 1,15,335 after deducting the cost of replacing the motor launch "Sylvia" with a more suitable craft. The launches recommended by the Chief Engineer carry a heavier type of engine and will burn more fuel. The estimate of the extra revenue expenditure required should therefore be raised by Rs. 3,000. Other than this revised estimate of the cost, Government have already approved of the main proposals embodied in this working plan, and the only impediment to their immediate introduction is the provision of the necessary funds.

**Necessity for immediate introduction of the scheme.**—The objects of this plan are described in paragraphs 5, 6 and 7 of Part II, and the effects of continuing the present system of management are indicated in paragraphs 104 to 107 of Part I. Each year's delay accentuates the ills described in these paragraphs, and will lengthen the time required to bring these forests back to their normal productivity. If the forests of the Sundarbans are to be conserved, if the local people and traders are to be supplied with the produce that they require, and if a serious fall in the average annual revenue is to be avoided, some sort of reorganisation on the lines recommended in this working plan should immediately be introduced.

**Assistance received in the compilation of the plan.**—The historical material for Part I of the report has been gleaned mostly from a perusal of the previous working plans in the division, old inspection reports by Conservators; etc. Other records which yielded interesting information were Pargiter's Revenue History of the Sundarbans and Mr. Fawcus' recent Settlement Report of the Khulna district. The latter was particularly helpful on the subject of tides and delta formation. As is usual with all working plans, I have borrowed word for word from previous plans whenever it has been found expedient to do so. Much help and advice has been received from Mr. Jeston Homfray, who has read over the draft of Parts I and II, and from Mr. A. K. Glasson, who has scrutinised paragraphs 1 to 54 of Part I and paragraphs 1 to 116 of Part II. The field-work for this plan was started by Mr. J. C. Nath, Assistant Conservator of Forests, on the 27th November 1926; on the 3rd April 1927, this officer handed over charge of the camp to Mr. S. A. Yusuf, Assistant Conservator of Forests, who continued in charge of both the field-work and the compilation of the valuation results, etc., until the 15th November 1928, when the writer took over direct charge of the compilation work. The Sundarbans jungle is notoriously difficult to traverse. In the east there were the blind root-suckers of *sundri* to contend with, and in the west a continuous dense thicket of *goran* to cut through.



In order to finish the work expeditiously, it was necessary for each enumeration party to swim across half a dozen small *khals* or so during the course of an average day's work. Consequently, the staff employed on the field-work is to be congratulated on finishing the enumeration of 2,123 miles of line through this difficult jungle, and stock-mapping an area of 2,473 square miles of forest in a period of 13 months. Of the subordinates who have given assistance, Babu Khirode Chandra Roy Chaudhury, Forest Ranger, and Babu Janardan, Das, Deputy Ranger, deserve particular mention; these two officers have displayed unflagging zeal and interest in the work, despite the fact that they have been employed continuously in this connection, both in the field and in the office, from the commencement of the enumerations in November 1926 up to date. The Forest Ranger has been particularly conscientious and accurate in the arduous task of compiling the valuation figures, etc. Much time and trouble has also been saved to the writer, by the care and accuracy with which Babu Madhu Sudan Mazumdar, temporary Clerk, has typed this plan.

S. J. CURTIS,

*Deputy Conservator of Forests.*

KHULNA,

*The 31st March 1931.*

# SUNDARBANS WORKING PLAN.

## Volume I.

### ERRATA.

(Slip No. 1.)

Page xiii of "Contents", 10th item of "Part II, Chapter I"—For "76 and 79-81" read "76 and 79-80".

Page xiv of "Contents", 12th item of "Chapter II"—For "102-105" read "102-103".

Page xvi of "Contents", last item of "Chapter VIII"—For "59-1601" read "159-160".

Page 14, 5th column of statement, first item—For "8" read "8·8".

Page 45, paragraph 91, second line—For "inhabitated" read "inhabited".

Page 94, 7th column of statement, "Passur fuel", 12th item—For "48" read "·48".

Page 109, first item of column 1—For "940-41" read "1940-41".

(Slip No. 2.)

Page v, Footnote to letter No. 563/81—Correct the spelling of "volumes".

Page 7, paragraph 2, line 7—For "peninsulars" read "peninsulas".

Page 14, first paragraph, line 7—Correct the spelling of "probability".

Page 14, paragraph 26, line 5—For "peninsulars" read "peninsulas".

Page 15, paragraph 29(1), at end of second line—delete "at".

Page 15, paragraph 30, second line—For "peninsulars" read "peninsulas".

Page 19, first paragraph, line 6—For "satisfactorily" read "satisfactory".

Page 22, paragraph 53, commencement of line 11—Delete "as".

Page 25, paragraph 65, line 7—Correct the spelling of "extensively".

Page 29, paragraph 69(1), lines 2, 3 and 7, paragraph 70, line 4, and page 30, paragraph 72, lines 4 and 5, paragraph 73, line 5—Delete "from" where followed by "thence".

Page 49, paragraph 103, line 15—For "1 feet" read "1 foot".

Page 54, first paragraph, end of line 3—After "1924-25" insert "to".

Page 69, heading above paragraph 125—For "b" read "by".

Page 73, paragraph 2—

Line 3—For "prescription" read "prescriptions".

Line 10—For "eaves" read "leaves".

Page 149, first paragraph, 9th line—For "determing" read "determining".

Gratis.

PART I.

Summary of Facts on which the Proposals are based.



## CHAPTER I.

### DESCRIPTION OF THE TRACT DEALT WITH.

#### Name and Situation.

1. The tract of land known as the "Sundarbans" is the southern portion of the Gangetic Delta bordering on the Bay of Bengal. It extends about 180 miles east to west, and 70 miles north to south, and comprises the major portions of the 24-Parganas, Khulna and Barisal districts. The derivation of the name "Sundarbans" is obscure. The most popular theory is that it is named after the principal tree found in it, namely *sundri* (*Heritiera minor*); at present, this tree is abundant only in the Khulna forests, but some centuries ago, it was the principal tree throughout the delta. Another, more probable theory seems to be that it is derived from the word "Samundar" or "Samudra ban," meaning "Sea-forest".

2. The forests to which this plan applies are confined to the Government forests of the Khulna and 24-Parganas districts. These forests are bounded on the north and west by cultivated lands settled either permanently or temporarily by Government; on the south, by the Bay of Bengal; and on the east, by the Baleswar or Haringhatta river. They extend 110 miles from west to east. In the extreme west, from the Muriganga to the Thakuran river, the forests consist of a few islands and peninsulars on the sea coast and within the larger rivers; further eastwards, the forests gradually extend inland, until in the Khulna district, the northern boundary is about 50 miles from the sea-face.

#### Configuration of the Delta, Rivers, Tides, Accretion and Erosion.

3. **General description.**—The forests occupy a flat deltaic swamp, most of which is under water during the high spring tides of the rains. The area is intersected by a close network of rivers, channels and creeks (vernacular *nadi*, *gang* and *khal*). The larger of these waterways are the remains of former beds of the Ganges, the main stream of which has gradually shifted eastwards, leaving a number of dead, or semi-dead rivers running north and south, which, but for tidal action, would have long ago silted up. At a comparatively recent period, all these rivers were connected with the Ganges; now, however, the only one which is a direct effluence, is the Baleswar, which leaves the Ganges at Kushtia. † Where it passes the northern boundary of the forests, this river is 2 miles in width; during the rains, the sea-water is fresh for some miles around its mouth, and it is responsible for most of the fresh-water that finds its way into the eastern part of the Sundarbans. (The Hooghly, also, is closely connected with the Ganges *via* the Julangi and the Bhagirathi, but it receives most of its stream from its own local water-shed: notably *via* its tributary the Rupnarayan river, which drains the Midnapore, Bankura and Hooghly districts. Owing to its great width, the estuary of the Hooghly remains salt during the rains. A number of rivers are in indirect connection, and receive the overflow of the Ganges during the rains, namely, the Passar, Sipsah, Arpangasia and Malancha, and, to a slight extent, the Jamuna and Raimangal\*. They also receive a considerable amount of local drainage throughout their long and meandering courses. ‡ Other rivers, such as the Matla, Thakuran and Saptamukhi, are now little more than arms of the sea; they have no connection at all with their original mother stream, and are brackish during the whole year. The more moribund rivers are in the west; consequently, the

\*The Passar is connected with the Ganges, *via* the long and winding courses of the Julangi and the Bhairab; it is also connected with the Baleswar *via* the Atharabanki, but it receives very little fresh-water by this latter stream which is kept open only by constant dredging by the Irrigation Department.

†The Sipsah is closely connected with the Passar, but does not receive nearly as much fresh-water.

‡The Arpangasia and the Malancha are connected with the Bhairab by the Kabadak river, and receive a certain amount of fresh-water during the rains.

§The Jamuna and the Raimangal join the Bhairab *via* the Ichamati, but the Ichamati is nearly silted up; these two rivers are only slightly less salt during the rains.

47. In addition to the volumes given in the preceding statements, the following are the average volumes of sound *keora* and *baen* per acre throughout the working circle:—

			Timber.	Fuel.
			C. ft.	C. ft.
<i>Keora</i>	..	..	16.97	9.40
<i>Baen</i>	..	..	21.46	17.95

(See details of enumerations and calculations in Appendix IX.)

As explained in paragraph 40 of Chapter I, the quality of these two species does not vary so much with the quality of the surrounding forest, but depends mainly on the zone in which found.

48. As indicated in paragraph 10, the species utilised in small sizes were enumerated in 11 foot squares at every 5 chains. The enumeration results for *amur* on this system may be found in Appendix IX. Compartments Nos. 21 to 37 inclusive and Compartment No. 40, have been excluded from the *Goran* Working Circle; consequently the enumeration results for *goran*, *singra* and *khalshi* in these compartments will also be found in Appendix IX under the enumerations for this working circle. Estimates of the average volumes per acre of these small species have been made, and are given in that appendix.

49. **The condition of the crop and the distribution of the age classes.**—The enumerations show that mature sizes of most species are in deficit, and that there is an excess of pole growth. Regeneration is satisfactory throughout the working circle: below the minimum enumerated size (namely, below 3 inches in diameter), sapling and seedling growth was noticed to be particularly well represented. It is only the older age classes that need examination. With the aid of the diameter increment curves for first and second quality *sundri* given in Appendix IV, it is possible to compare the volume of the growing stock in each age class for this type of tree. On the assumption that the shapes of their diameter increment curves are similar to either that of first quality or that of second quality *sundri*, comparisons have also been made of the stocking of the age classes in third quality *sundri*, the three qualities of *gengwa*, and first and second quality *passur*.

50. **Sundri.**—

Age class.	Age period.	Corresponding diameter class.	Volume of timber and fuel per acre.
	Years.	Inches.	C. ft.
<b>First quality</b> (rotation = 134* years).			
III	.. 45 to 67	3.2 to 5.1	348
IV	.. 67 „ 89	5.1 „ 7.5	462
V	.. 89 „ 112	7.5 „ 10.3	315
VI	.. 112 and over	10.3 and over	154
<b>Second quality</b> (rotation = 126* years).			
III	.. 42 to 63	2.9 to 4.5	272
IV	.. 63 „ 84	4.5 „ 6.2	269
V	.. 84 „ 105	6.2 „ 8.0	182
VI	.. 105 and over	8.0 and over	128
<b>Third quality</b> (rotation = 121* years).			
III	.. (not enumerated.)		
IV	.. 60 to 80	3.5 to 4.8	167
V	.. 80 „ 101	4.8 „ 6.25	160
VI	.. 101 and over	6.25 and over.	181

\*In order to divide up the stock into age classes, it has been necessary to fix the rotations; the method used for estimating the rotations for each quality of each species, is explained in paragraph 57.

The ideal distribution of age classes for a *sundri* selection forest is not known; when young, its natural tendency is to grow in a very thick stand. However, except in the third quality forest, there is no doubt that the oldest age class is still considerably short of its normal figure and that poles and saplings are much in excess. The latter is the natural result of the lack of demand for fuel from the subsidiary thinnings during the currency of the last plan.

51. *Gengwa*.—

Age class.	Age period.	Corresponding diameter class.	Volume of timber and fuel per acre.
	Years.	Inches.	C. ft.
<b>First quality</b> (rotation = 115* years).			
III ..	38 to 57	3.25 to 5.2	134
IV ..	57 „ 76	5.2 „ 7.6	108
V ..	76 „ 95	7.6 „ 10.5	36
VI ..	95 and over	10.5 and over	10
<b>Second quality</b> (rotation = 110* years).			
III ..	37 to 55	3.1 to 4.8	152
IV ..	55 „ 73	4.8 „ 6.75	114
V ..	73 „ 92	6.75 „ 8.9	37
VI ..	92 and over.	8.9 and over.	10
<b>Third quality</b> (rotation = 105* years).			
III ..	35 to 53	2.7 to 4.1	145
IV ..	53 „ 70	4.1 „ 5.6	126
V ..	70 „ 88	5.6 „ 7.25	73
VI ..	88 and over.	7.25 and over.	35

The shortage in the last two age classes of this species is apparent. *Gengwa* is a light-demander compared with the shade bearing *sundri*; consequently the shortage of the older trees is further accentuated by the fact that the advance pole and sapling growth of this species beneath the standing crop is not so thick.

52. *Passur*.—The quality of this species varies little throughout the forests classified as first and second quality. The figures for these two qualities have therefore been combined :—

Age class.	First and second quality (rotation = 134* years).		
	Age period.	Corresponding diameter class.	Average volume of timber and fuel per acre.
	Years.	Inches.	C. ft.
III ..	45 to 67	3.2 to 5.1	12
IV ..	67 „ 89	5.1 „ 7.5	17
V ..	89 „ 112	7.5 „ 10.3	15
VI ..	112 and over.	10.3 and over.	10

\*In order to divide up the stock into age classes, it has been necessary to fix the rotations; the method used for estimating the rotations for each quality of each species, is explained in paragraph 57.

*Passur* (concluded) :—

It is evident from the foregoing figures that the age distribution of this species is somewhat better than that of *sundri*. *Passur* is a fairly heavy shade bearer; the younger age classes therefore cannot be considered much in excess. As with the *sundri*, there is still a deficit in the oldest age class. In the third quality forest, too few *passur* trees were enumerated to give a reliable average distribution. From an examination of the average volumes per acre of third quality *passur* in paragraph 46, it would appear that there is an excess of the oldest age class. This is due to the fact that the exploitable girth used during the currency of the former plan was 1 foot, irrespective of the quality of the forest; consequently, the mature sizes in the third quality forest have been left unexploited.

53. **Other species.**—The next tree in importance in the working circle is *baen*. This species has been very seriously overcut; sound mature trees are comparatively rare. During the currency of the former plan, the felling of *baen* was not regulated. Under this mode of treatment, the custom of many woodcutters was to lop branches of large trees for fuel or for small logs, with the result that most trees of any size are either unsound or absolutely hollow. The state of the *keora* crop is much more satisfactory. Owing to under-felling during the last 25 years, a certain proportion of overmature trees have become unsound, but there is a fairly large supply of sound mature *keora* which will compensate for the shortage of *baen*. The two most important small species to be worked under the prescriptions of this circle, are *amur* and *singra*. The felling of *amur* was regulated under the former system of management and its stocking is satisfactory; on the other hand, the felling of *singra* was not regulated, and as a consequence, this species has been badly over-felled. It should be noted that *singra* will be worked under the prescriptions for this working circle only in certain compartments [see Felling Rule (10) in paragraph 67].

#### Method of Treatment.

54. **The silvicultural system.**—In the last plan most of this working circle was included in that part of the old Eastern Working Circle, in which the *sundri* was worked under what amounted to improvement fellings combined with thinnings on a felling cycle of 20 years. (See paragraph 103, Part I.). *Sundri* being a fairly heavy shade-bearer, regeneration has been satisfactory under this system; without having experimented with any sort of regular method, it would be unsound to prescribe any system other than selection. The main disadvantage of a regular system is that *sundri* seedlings will not establish themselves readily, except under fairly heavy shade; if exposed, they dry off during the hot weather when the rivers are low and only a small portion of the forest is covered at high tide. Under this system, it would also be difficult to protect against wind damage, and the ingress of weeds such as *Pandanus*, fern and *Hibiscus*, which are very liable to invade cleared areas. The selection system, therefore, has been retained; but the time has come to make the prescriptions more definite; exploitable diameters have been fixed; and, although the fellings have been prescribed by area, a volume check has been added. The forests still contain many defective trees, and the proportion of the older age classes is still deficient; consequently, the fellings will continue to be of an improving nature. The system introduced may be termed "Selection cum Improvement Fellings."

55. This system has been extended to all important species, whereas before, regulations were prescribed only for *sundri*. The importance of these other species has already been pointed out in paragraph 5 of Chapter I; they require silvicultural treatment just as much as *sundri*. Under the former method of one coupe only for *sundri*, the exploitation of *passur*, *keora* and *kankra*, which was confined to this coupe, was neglected. With the four felling series now prescribed, it will be possible to utilise these species more fully; they are expected to yield a considerable amount of mature timber. With regard to other species, such as *genwa* and *baen*, owing to the disastrous results of unregulated cutting during the currency of the last plan, their fellings will be more of the nature of improvements and thinnings of the younger age classes than selection.

56. **The felling cycle.**—The former felling cycle of 20 years has been retained. This period has been fixed to suit the needs of first and second quality *sundri*, which are the principal types of tree in this working circle. The average exploitable diameters of these two types of tree are 12 inches and 9 inches respectively; during a period of

20 years, the average first quality *sundri* tree grows from 7·9 inches to 12 inches in diameter, and that of second quality grows from 7·2 inches to 9 inches in diameter. (Vide the diameter increment curves in Appendix IV.) In the first quality forest, the enumerations show that there is an average per acre of 33·2 *sundri* trees between 8 inches and 12 inches diameter, and only 2·8 stems per acre which have reached, or exceeded the exploitable diameter of 12 inches; in the second quality forest, similar averages show 21·9 trees between 7 inches and 9 inches in diameter, and 6·9 stems of and above the exploitable size. During the next 20 years, therefore, there is no doubt that there will be a gradual increase in the number of trees available on each succeeding coupe, which will have reached the exploitable sizes, and which will be available for selection. Under the prescription of 3 feet exploitable girth, fixed by the former plan for *sundri* of all qualities, many over-mature trees have been left in the second quality forest, very often at the expense of trees approaching the present exploitable sizes, which have been thinned in order to give these over-mature trees space. In the second quality forest, therefore, the increase will not be so marked. But, from an examination of the figures for the distribution of the age classes in paragraph 50, it is evident that, even after allowing for thinnings and casualties during the 20 years of this plan, the number of large sized trees per acre will continue to improve after this 20-year period is over, and that during the second felling cycle under this management the *sundri* crop should attain a normal distribution of age gradations for a selection forest. With regard to the needs of other species, *gengwa* is the only one which is found growing gregariously to any extent, and for which the length of the felling cycle is important. This species, although of quicker growth than the *sundri*, has been much overcut; consequently, the fellings will be comparatively light during the first felling cycle. If this management is continued over a second cycle, *gengwa* will be able to stand the comparatively heavy fellings expected, because its seedlings do not require the same amount of shade as those of *sundri*.

57. **The rotations.**—The exploitable diameter of first quality *sundri* has been fixed at 12 inches, corresponding to an age of 123·9 years. With a felling cycle of 20 years, the average age of mature trees exploited will be 133·9 years, corresponding to a diameter of 13·3 inches; in other words, the average rotation for first quality *sundri* will be 134 years. Similarly, the rotations for other qualities and species in this working circle will be 10 years more than the exploitable age. It has been pointed out in the foot-note to the statements of average volumes per acre in paragraph 46, that the third quality *sundri*, *gengwa* and *passur* in this working circle is of much better quality than the average of this quality class. For this reason, the average exploitable diameter of third quality *sundri* in this circle has been fixed at 7 inches, corresponding to an age of 110·6 years, that of third quality *gengwa* at 8 inches, corresponding to an age of 95·5 years, and that of third quality *passur* at 10 inches, corresponding to an age of 118·6 years. The average rotations for the three principal species, in each quality class, are therefore as follows:—

		Rotations in years.		
		<i>Sundri.</i>	<i>Gengwa.</i>	<i>Passur.</i>
First quality ..	..	134	115	134
Second quality..	..	126	110	134
Third quality ..	..	121	105	129

58. **Calculation of the yield for *sundri*.**—In previous paragraphs, it has been pointed out that the younger age classes of *sundri* are very much in excess, and that the demand for small poles and fuel is not nearly equal to the supply; consequently, it is not necessary to regulate the volume of the yield from the smaller sizes and fuel. Furthermore it would be difficult and expensive to control the felling of the small stuff, owing to the necessity of enumerating and recording the diameter and quality of each tree felled. It is proposed, therefore, to calculate the yield, and to equalise the outturn of timber, only from the trees of 6 inches diameter and over: it is the trees of this class, which yield the bulk of the revenue on the *sundri*, and for which there is the most demand.



59. The yield has been calculated by Hufnagel's method, based on the formula :—

$$Y = \frac{V_p + \frac{1}{2}p I}{p}$$

where,  $Y$  = the possible yield,  $V_p$  = the volume of the timber in the oldest age class of "p" period of years, and  $I$  represents the current annual increment of the age class.

This formula can be written  $Y = \frac{V_p}{p} + \frac{I}{2}$ . In this case, the yield from stems of

6 inches in diameter and over is needed; consequently, "p" has been taken as the difference between the rotation and the age of the average tree of 6 inches in diameter, and  $V_p$  has been taken as the volume in trees of 6 inches in diameter and over. The volumes per acre in each quality of forest have been calculated from the sound trees only; likewise, the control will be for sound trees only; but in order to allow for subsequent casualties amongst the sound trees, 25 per cent. has been deducted from the yield as calculated by the formula. Owing to the excess of the smaller sizes, both the volume and increment of trees passing the 6 inches diameter bar during the felling cycle will be greater each year; it is clear, therefore, that the method of calculation chosen will be safe from all possibility of an over-estimate.

60. The following gives the calculation of the yield of timber per average acre from apparently sound trees of 6 inches diameter and over, for each of the three qualities of forest :—

### First quality Sundri.

Calculation of  $I$ , the current annual increment for the average acre :—

Diameter class.	Period taken to grow through the diameter class.	Increment of timber of the average tree during growth through the diameter class. (Taken from the volume table curve.)			Current annual increment for the average tree.	Timber volume of the average tree (vide Appendix V).	Volume of sound timber in the average acre. (Vide paragraph 46).	Current annual increment of timber in the average acre.
		C. ft.	C. ft.	C. ft.				
Inches.	Years.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	
6 to 7	9.5	3.0	to 4.4	= 1.4	.1474	3.7	158.19	6.301
7 „ 8	9.0	4.4	„ 5.9	= 1.5	.1667	5.1	136.33	4.455
8 „ 9	8.2	5.9	„ 7.4	= 1.5	.1829	6.6	110.03	3.050
9 „ 10	7.5	7.4	„ 9.1	= 1.7	.2267	8.2	71.81	2.107
10 „ 11	7.1	9.1	„ 11.4	= 2.3	.3239	10.1	54.58	1.750
11 „ 12	7.1	11.4	„ 14.2	= 2.8	.3944	12.8	30.53	.941
12 „ 13	7.6	14.2	„ 17.1	= 2.9	.3816	15.8	20.26	.489
13 „ 14	9.9	17.1	„ 19.5	= 2.4	.2424	18.4	11.66	.154
14 „ 15	16.4	19.5	„ 21.1	= 1.6	.0976	20.4	7.74	.037
15 „ 16	32.2	21.1	„ 22.2	= 1.1	.0342	21.7	4.55	.007
16 and over.	Annual increment negligible.			..	..	7.26	..	..
Total ..						612.94	19.291	

Calculation of the possible annual yield for the average acre :—

$V_p = 612.94$ ,  $I = 19.291$  c. ft. Rotation = 133.9 years, average age of a tree of 6 inches diameter = 75.5 years; therefore  $p = 58.4$  years. Consequently, the yield of sound trees per acre =  $\frac{612.94}{58.4} + \frac{19.291}{2} = 20.141$  c. ft.; less 25 per cent. for casualties, it equals 15.11 c. ft. of timber per annum.

**Second quality Sundri.**

Calculation of I, the current annual increment for the average acre :—

Diameter class.	Period taken to grow through the diameter class.	Increment of timber of the average tree during growth through the diameter class. (Taken from the volume table curve.)			Current annual increment for the average tree.	Timber volume of the average tree (vide Appendix V).	Volume of sound timber in the average acre. (Vide paragraph 46).	Current annual increment of timber in the average acre.
		C. ft.	C. ft.	C. ft.				
6 to 7	11.8	2.8	to	3.9 = 1.1	.0932	3.3	95.03	2.684
7 „ 8	11.1	3.9	„	4.9 = 1.0	.0901	4.4	63.83	1.307
8 „ 9	10.9	4.9	„	6.1 = 1.2	.1101	5.5	40.56	.812
9 „ 10	12.3	6.1	„	7.4 = 1.3	.1057	6.7	22.87	.361
10 „ 11	18.4	7.4	„	8.9 = 1.5	.0815	8.1	13.32	.134
11 „ 12	41.4	8.9	„	10.7 = 1.8	.0435	9.8	8.76	.039
12 „ 13	87.0	10.7	„	12.7 = 2.0	.0230	11.7	3.99	.008
13 „ 14	..*	12.7	„	13.8 = 1.1	..*	13.2	2.39	..*
14 and over.	..*	13.8	„	14.0 = .2	..*	14.0	5.79	..*
Total ..							256.54	5.345

\*Period taken to grow 1 inch in diameter is very long; the current annual increment per acre is, therefore, negligible.

Calculation of the possible annual yield for the average acre :—

$V_p = 256.54$ ,  $I = 5.345$  c. ft. Rotation = 125.9 years, average age of a tree of 6 inches diameter = 82.8 years; therefore,  $p = 43.1$  years. Consequently, the yield of sound trees per acre =  $\frac{256.54}{43.1} + \frac{5.345}{2} = 8.625$  c. ft.; less 25 per cent. for casualties, it equals 6.47 c. ft. of timber per annum.

**Third quality Sundri.**Calculation of I, the current annual increment for the average acre. (Based on the assumption that the diameter increment curve is similar in shape to that of second quality *sundri*):—

Diameter class.	Period taken to grow through the diameter class.	Increment of timber of the average tree during growth through the diameter class. (Taken from the volume table curve.)			Current annual increment for the average tree.	Timber volume of the average tree (vide Appendix IX).†	Volume of sound timber in the average acre. (Vide paragraph 46).	Current annual increment of timber in the average acre.
		C. ft.	C. ft.	C. ft.				
6 to 7	13.45	2.50	to	3.45 = .95	.0706	2.97	65.26	1.552
7 „ 8	15.65	3.45	„	4.45 = 1.00	.0639	3.93	39.65	.645
8 „ 9	30.24	4.45	„	5.45 = 1.00	.0331	4.97	21.56	.143
9 „ 10	100.00	5.45	„	6.35 = .90	.0090	5.90	12.26	.019
10 „ 11	..*	6.35	„	7.18 = .83	..*	6.77	6.02	..*
11 „ 12	..*	7.18	„	7.83 = .65	..*	7.53	3.17	..*
12, and over.	..*	.....*			..*	8.00	4.34	..*
Total ..							152.26	2.359

\*Period taken to grow 1 inch in diameter is very long; the current annual increment per acre is, therefore, negligible.

†According to the special volume table for third quality forest in this working circle.

Calculation of the possible annual yield for the average acre :—

$V_p = 152.26$  c. ft.,  $I = 2.359$  c. ft. Rotation = 120.57 years, average age of a tree of 6 inches diameter = 97.12 years; therefore,  $p = 23.45$  years. Consequently, the yield of sound trees per acre =  $\frac{152.26}{23.45} + \frac{2.359}{2} = 7.673$  c. ft.; less 25 per cent. for casualties, it equals 5.75 c. ft. of timber per annum.

The yield for this quality is comparatively large, when compared with that of second quality, because the volume in the last age class is nearer normal. (Vide paragraph 50.) In the last plan, the same exploitable size was used for this quality as in the better qualities; hence, a greater proportion of mature trees has been left.

61. With the aid of the yields per average acre calculated in the previous paragraph, the annual yield of *sundri* timber from sound trees of 6 inches in diameter and over, has been calculated for the whole working circle. This yield, together with the yields of each felling series, is given in the following statement:—

Quality of forest.	The average annual yields for each felling series, as calculated from the yields of each type. [Vide Appendix IX, 5 (2).]				Total area of the working circle.	Total possible annual yield of the working circle.
	Felling Series 1.	Felling Series 2.	Felling Series 3.	Felling Series 4.		
	C. ft.	C. ft.	C. ft.	C. ft.	Acres.	C. ft.
First .. .. .	670,778	613,708	153,049	..	95,138	1,437,535
Second .. .. .	441,088	458,898	614,610	428,882	300,383	1,943,478
Third .. .. .	33,647	65,847	70,148	14,657	32,052	184,299
Maidan .. .. .	..	..	..	..	1,275	..
Total ..	1,145,513	1,138,453	837,807	443,539	428,848	3,565,312

The above yields, though merely estimates, may indicate greater accuracy than warranted by the data on which they are based; they are therefore approximated to the nearest lakh of cubic feet for the circle, as follows:—

1,150,000	1,150,000	850,000	450,000	428,848	3,600,000
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62. **The calculation of the yield of gengwa and passur.**—For similar reasons to those indicated for *sundri* in paragraph 58, it is proposed to prescribe the yield of *gengwa* and *passur* only for timber obtained from apparently sound trees of 6 inches diameter and over. The rotations for these species are merely estimates, and the shape of the diameter increment curves are unknown; Hufnagel's formula is therefore not practicable; but as it is important to have some sort of approximate check on the felling of these two species, their yield has been calculated according

to the formula  $Y = \frac{rV_p}{p(r - \frac{1}{2}p)}$ , where  $Y$  = the possible yield,  $V_p$  = the volume of timber in the oldest age class of "p" period of years, and  $r$  = the rotation. (The formula is based on the principle of Von Mantel's formula  $Y = \frac{2V}{r}$ , where  $V$  = the volume of the whole growing stock.) With this method, it has been necessary to estimate only "p" and "r". It has been found with regard to the *sundri*, that

the equation chosen,  $Y = \frac{rV_p}{p(r - \frac{1}{2}p)}$ , gives a result within 3 per cent. of the total

yield of *sundri* for the whole working circle as worked out in the previous paragraphs; consequently, although the formula is actually one for the yield of mature trees only, it will give an approximately correct result in this case, and the thinnings may

water in the rivers of the west is more salt, and the forest growth is inferior. The silting up of the headwaters of these western rivers is still in progress, the result being that less fresh-water passes down them, and they become more salt every year. The larger estuaries are upwards of a mile in width where they enter the forest, and three to four miles in width where they debouch into the Bay of Bengal.

Into these rivers and *gangs*, flow innumerable small creeks (locally called *khals*), caused by the scour when the water drains off the swamps at each successive ebb-tide. The sources of most *khals* are in low areas in the centre of the islands. These areas are called *bils*. (*Bils* are much more pronounced in the western forests than they are in the east. In the 24-Parganas district, a *bil* may be as much as 5 feet or 6 feet below the level of the remainder of the forest, such a *bil* is devoid of tree growth): in the forests east of the Passar, the difference is very seldom more than one or two feet, and the blanks, if any, are small. This is usually the case in the best *sundri* forest. Except where new *chars* are forming, the banks of the rivers and *khals* are generally the highest ground; the level becomes gradually lower as one proceeds towards the *bil* in the interior of the island.

Some *khals* join up one stream with another; these are called *bharani*, or *duania*, as opposed to *mara khals*, which gradually split up into smaller *khals* until they are lost in the forest. *Bharani khals* are very important for communication, especially when they run east and west, and join up two rivers or estuaries. Due to the *bunding* or *dyking* of lands under cultivation preventing the tidal scour, the small side channels and *khals* in the cultivated areas very quickly silt up; this is very evident outside the north-eastern boundary of the forest, where the former routes of export from the Bhola river to Morrelganj and Bagerhat, have closed up during the last 30 years.

4. **The tides.** From the above brief description, it is evident that the ebb and flow of the tide controls the formation of the islands, and by the scouring action of the drainage during the ebb, keeps the rivers and *khals* open. The tidal wave sweeps over the area twice a day, the tidal current changing its direction after every 6 hours. The tides penetrate further inland, and the maximum rise and fall occurs during the spring tides of the first equinox in March and April, when there is very little stream in the rivers for the tide to contend against. During the rains, there is no flow-tide in the Passar river above Chalna, and there is a difference of only one or two feet in the tide level at Khulna. In the streamless rivers of the Western Sundarbans, the effect of the tide is felt far into the interior, the rise and fall tends to be more constant throughout the year, and varies only with the phases of the moon.

5. The tidal waves travel from sea-face to the interior, at a speed varying from 30 miles an hour at the sea-face to about 15 miles an hour in the upper reaches. The tidal current in the large rivers usually varies from 2 miles an hour near the sea-face to 4 miles an hour in the northern part of the forests, but during the spring tides, currents of about 6 miles an hour, or more, are often met with; the swiftest currents are formed by the combined ebb and stream of the rivers during the rains. The tidal wave makes its way across the Sundarbans from west to east; consequently, the tide changes earlier in the Hooghly and the Matla, than it does in the rivers further east. Owing to the combination of tidal wave and current, it is possible, when travelling in a launch from the sea inland, to move with the flow-tide for several hours at a time: when going in the direction of the ebb, a launch has to traverse the tidal wave, and the current will assist it only for 2 or 3 hours at a time. For this reason, steam launches and cutters should always go with the tide when returning to Khulna, but cannot be expected to do so, when travelling in the opposite direction.

6. The increase in the speed of the tidal current further inland is due to the gradual constriction in the width of the rivers, combined with the large spill area in the surrounding swamp forest. The tidal current in the large rivers continues to run, on its own momentum, an hour or so after the tidal wave has passed; consequently, at the end of the ebb, the suction of the current deepens the trough of the tidal wave, and, by retarding the progress of the oncoming wave, causes it to bank up, and heighten its crest. For this reason, the largest rise and fall of the tide is found where the tidal currents are the swiftest; this is generally in the northern part of the forests, because, although the rivers are usually narrower still further north, the *bunds* around the colonized lands lessen the spill area, and the effect of the tides gradually becomes less and less. The average rise and fall near the sea-face is about 7 feet;

further up the rivers it increases to an average of about 10 feet in the Khulna district and in the moribund rivers of the 24-Parganas district, where the tide has little or no stream to contend against, an average rise and fall of 16 feet is common. The following table, prepared from the figures supplied by the Irrigation Department for the year 1926, gives an indication of the rise and fall in the localities to the north of the forests :—

1926.

Locality.	Average rise and fall.		Maximum Spring tide.	Minimum Neap tide.
	Spring.	Neap.		
	Feet.	Feet.	Feet.	Feet.
Khulna .. ..	4·9	3·1	6·6	0·6
Jalma .. ..	6·0	3·0	8·8	1·2
Chalna .. ..	7·0	3·3	9·5	2·0
Bagerhat .. ..	5·6	3·2	7·8	1·0
Asthail .. ..	1·7	0·8	2·5	0·2
Habragang .. ..	8·6	4·8	9·8	3·9
Basantapur .. ..	13·0	6·8	14·6	5·5
Kaliganj .. ..	12·1	6·6	13·7	4·7
Koikhali .. ..	13·4	6·2	15·9	4·1

7. The fact that the tidal current in the large rivers continues to run for a short period after the tidal wave has passed, also accounts for the peculiarity, so frequently noticed, of the current in a small *khal* being in the reverse direction to that in the river of which it is a tributary. The wind has a great influence on the tidal flow. When the south winds set in, the flow continues for a longer period, and the contrary happens with a north wind. During cyclones, the wind causes storm waves; in the cyclone of October 1909, the flood tide was observed to continue rising long after the hour at which the ebb should have set in; a similar phenomenon occurred during the cyclone of 1919.

8. **Accretion and erosion by the rivers.**—Erosion and compensatory accretion are occurring continually here and there along the banks of all larger rivers, but the rivers of the Sundarbans are much more stable than the main streams of the Ganges and the Brahmaputra further east. Generally, erosion occurs on the outer bank of a curve, and accretion forms in slack water behind the inner bank of a curve. Also, new accretions and islands are continually forming in the slack water of rivers and *khals*, which do not receive sufficient tidal scour or stream to justify their width.

9. **The development of the Delta: The Eastern Sundarbans.**—The more eastern rivers are silt-carrying, and deposit silt over the surrounding forest swamp at every high tide during the rains; most of this silt is deposited directly the water loses its speed and starts to spread slowly over the swamp; consequently, the banks of rivers and *khals* generally become higher than the rest of the swamp in the interior; this forms a natural water-shed, and another smaller *khal* or creek

forms to drain it. The banks of this smaller *khal* are in turn raised, and the process is repeated on a continually diminishing scale, until the very small creeks draining the *bil* areas in the middle of the islands are formed. In this way, the general level of the whole swamp is gradually raised, and a close network of *khals* and creeks are formed to drain it. This gradual rise in level is counteracted to some extent by hypogene agencies, the nature of which is explained in paragraph 14. The coarser grained sand is dragged down the river-beds to the sea. The silt deposited on the top of existing islands during each flood, consists only of the finer particles; on settling down, this produces a heavy tenacious clay, which is the typical soil of the delta.

10. The silt which is not deposited within the delta, or which is scoured off again by the small creeks during the ebb, together with the heavier sand, is deposited at the mouths of the rivers; thus each river forms a bar, which eventually develops into an island or islands. The river then forms a fresh channel around this obstruction, or breaks up into two or more channels, and starts forming fresh bars and islands: in this way, the delta extends and develops. When a bank or *char* starts to form on the sea-face, only the heavier particles of sand are deposited; the finer silt is washed off by the waves. Most of this silt gradually sinks deep down to the shelf of the sea-bed further out in the bay, and forms the foundations for the further spread of the delta; also, large deposits of silt tend to form in the more sheltered localities near the sea-face, such as around the mouth of the Bheda *khal* near Dubla, or behind the new sandy formation at Katka.

11. The sand banks formed at the mouths of the rivers, are blown up into dunes above high tide level by the strong winds of the south-west monsoon. These dunes commence by the sand being piled up by the wind against any odd pieces of waif wood and other rubbish from the forest washed up by the waves; when once they start, their development is assisted by the rapid growth of *marram* grass, and a sandy island is quickly formed. In the lee of a new island where there is protection from the waves, the finer silt is deposited, causing the formation of a mud flat behind the dunes. Meantime, the sand is being continually piled up against the dunes, blown off the top during every high wind, and distributed over the mud flat; in this way, a flat stretch of sandy loam is formed above the high tide level, which, being unsuitable for ordinary delta forest growth, develops into a grassy *maidan*; this sandy *maidan* continues to spread until it is arrested either by a *khal*, or by early forest growth: the trees, both by their action as a wind-screen and the more direct obstacle of their rhizophors, tend to stop the further progress of the sand. This process will go on, and the sandy *maidan* will continue to spread and gradually rise in level, as long as the windward side of the island remains unprotected from the waves. As soon as a fresh island forms further out to the windward, the shore on the island behind begins to receive a supply of silt instead of sand, and the dunes behind gradually blow away; but traces of dunes, which have been protected quickly by forest growth, may occasionally be found some distance in the interior of the forest. The remains of the sandy *maidans* are found more often, covered as a rule by a growth of *gengwa* (*Excæcaria Agallocha*): a typical example may be seen on the western bank of the Marabhola. From the nature of their formation, one would expect to find sand dunes only on coasts unprotected from the south-west monsoon, and such is the actual case. On the other hand, sea erosion takes place on exposed eastern coasts, where the waves wash away the silt, and the wind blows away the sand.

12. **The Western Sundarbans.**—As one proceeds further westwards, and the rivers carry less and less silt, the changes occurring in the delta are of quite different character. From the Raimangal westwards, there is practically no silt in the rivers, except that which is obtained from the scour off the forests and other spill areas during the ebb. This silt is transferred to the beds of the larger rivers, which will continue to silt up until they constrict to a size which the scour is capable of keeping open. This continual scour off the forests during the ebb, without sufficient compensatory silting during the flood, is gradually enlarging the *bil* areas in the interior of the islands, and widening the smaller side *khals*: the *bils* are much larger, and the side *khals* are much wider in the Western Sundarbans, than they are in the east. On the sea-face, more erosion than accretion is occurring; the silt of the spill areas does not form *chars* on the sea-face, but tends to wash up the rivers, or is deposited out at sea on the shelf of the sea-bed.

13. In the extreme west, the Hooghly and its effluent the Muri Ganga, or Channel Creek, are again silt and sand-carrying rivers, and land building is still in progress. Owing to the great width of their estuaries, the new islands in the vicinity of the sea consist of wave beaten and windswept sand banks; but silt deposits have just started in the more sheltered pockets on Sagar Sand, and muddy *chars* are found further up the estuaries, such as the Lohachara *char* at the northern mouth of Channel Creek, and the Kankramari *char* at the mouth of the Duar Agra.

### Underlying Rock and Soil.

14. The whole formation on which the Sundarbans forests lie, is geologically very recent; it consists of a deep alluvium, which, like that of the rest of the Bengal plain, has been washed down from the gneissic and other formations of the Himalayas. Mica, so commonly found in the Himalayas, can be seen glistening both in the sand on the seashore, and in the silt deposited further up the rivers. The subsoil consists of alternate layers of clay and sand, gradually changing into shales and sandstone, which no doubt exist to a very great depth. The original rock on which the alluvium rests, has never been reached. In the upper clay levels, peaty debris and the remains of the more durable timber of the swamp trees are found. Recently, during the excavation of the King George's Dock at Calcutta, fragments of the wood of *Ceriops* species were found at about 40 feet below the ground-level, or about 25 feet below the sea-level. At one time, these trees and other vegetation must have been growing at or above sea-level; the cause of these remains, together with the soil on which they were growing, sinking to such a great depth needs explanation.—The enormous weight of material which the Ganges and the Brahmaputra transfer from the Himalayas to the delta each year, disturbs the equilibrium of the earth's crust. For this reason, by slow seismic action the foundations of the delta have been gradually lowered, and the foundations of the Himalayas gradually raised. This gradual lowering is not necessarily uniform: the continual chain of *bils* which stretch from Madaripur in the east, across the northern parts of the Khulna and 24-Parganas districts, as far as the Rajapur *bil* in the Howrah district, is probably the result of a greater sinking beneath this zone, than beneath the country further to the north or south. The occasional mild earth tremors and earthquakes, which are felt in the delta districts, are undoubtedly due to this general subsidal tendency. On occasions—happily quite rare—a large and sudden subsidence occurs, such as in the earthquake of 1897 which produced the *bils* in Rangpur and Mymensingh. In the area which is known now as the Sundarbans, I do not think that the remains of the surface growth have been found below 30 feet: underlying strata have been found to be devoid of these remains. This seems to indicate that, since this part of the delta started forming, the subsidence has not been more than about 30 feet.

15. In the subsoil down to about 40 to 50 feet, clay generally predominates in the higher levels, and the sand is found mostly in the substratum beneath; but this is by no means always the case, frequently, layers of sand are found above a deep stratum of clay: such layers are either the remains of old river-beds which have shifted on top of formerly deposited mud, or the remains of old sea-faces where accretion has started again after a period of erosion, both the sinking of the mud and the erosion being due to the gradual sinking of the Sundarbans as already explained.

16. The surface soil of the forest area consists of a close tenacious clay: except near the sea-face, sandy patches are very rare; presumably, most of the remains of the sandy *maidans* of old sea-faces either have been washed away by erosion of the rivers, or have sunk and been covered with mud. Nothing to compare with the high levels of the Irawaddi Delta is found. In the eastern part of the Sundarbans, where the rivers supply fresh silt each year, the top dressing is soft and fertile: in the Western Sundarbans where there is no fresh supply of silt each year, even the surface soil has settled down to a hard mass, and the ground is much less suitable for tree growth.

### Climate.

17. The forests lie just south of the Tropic of Cancer, between latitude 22° 30' on the north and 21° 30' on the south. The climate is humid and the rainfall large; as in all damp climates near the sea, the temperature is equable. The following table,

prepared from figures supplied by the Meteorologist of India, gives the temperature, humidity and rainfall of the four recording stations nearest to the forest :—

Observatory.	Shade temperatures.				Average humidity at 8 a.m.	Average yearly rainfall.
	Average daily maximum.	Average daily minimum.	Average annual maximum.	Average annual minimum.		
	°F.	°F.	°F.	°F.	Per cent.	Inches.
Calcutta (Alipore), 1919-1928 ..	87.9	71.4	105.2	49.3	84.0	63.37
Saugar Island, 1919-1928 ..	84.9	73.2	97.5	50.7	81.1	69.04
Satkhira, 1923-1928 ..	88.9	70.3	104.2	45.3	83.7	62.75
Khulna, 1922-1928 ..	87.2	70.3	100.3	47.3	80.1	63.33

The figures for temperature of Saugar Island, on the sea-face at the mouth of the Hooghly, are probably true for the sea coasts of the forests further to the east. The hot weather begins about the middle of March, and ends about the middle of June; the cold weather commences at the beginning of December, and finishes at the end of February. The climate of the forests is more equable than that of the inhabited localities further north; within the forest area, temperatures of over 100° F and lower than 47° F are very rare. The maximum day temperatures average from about 75° F in January to about 90° F in April.)

18. The true rainy season starts about the middle of June and ends about the middle of September, but a considerable amount of rain falls during the storms of the Spring and Autumn months, and occasionally a light fall occurs in December or January. On the sea coasts of the Khulna district, where the trees are taller and the forests denser, the percentage of humidity and the volume of rainfall are probably slightly larger than at Saugar Island on the west. The average annual rainfall within the forests probably varies from about 72 inches on the sea-face, to about 65 inches near the northern boundary.

19. From October to the middle of March, the prevailing winds are from the north and north-east; in January and February, calms frequently occur, causing thick ground mists in the early morning. The south-westerly monsoon starts about the middle of March, and finishes about the end of September. The winds of the monsoon blow with a sustained violence, often for weeks on end; they make the large rivers impassable for the smaller boats. The highest and most turbulent waves occur during the ebb, when the tide is in the opposite direction to the wind. Empty boats are often held up for a week or so, before they can proceed to the forests for their cargo, and loaded boats with small free-board are frequently delayed for some days, before they can venture out into the large rivers leading to the north. As a rule, the calmest time during the monsoon is the early morning. Until the middle of June, the cooler north-westerly winds frequently crop up in the shape of violent cyclonic storms. These storms are short, sudden and severe, and are generally accompanied by a fall of rain. They are very destructive; every year, small country boats are caught in the middle of large rivers by these storms and sunk. Many of the boats coming out of the forests heavily laden with forest produce are caught in this way. Storms also occur during the change in the monsoon in October and early November; as a rule, autumnal storms last longer, and are accompanied by more rain and less wind than those of the Spring.

20. Occasionally, a much more serious type of cyclone develops, which travels up from the south. Such cyclones have occurred in May 1833, June 1842, October 1848, May 1852, October 1864, November 1867, May and June 1869, and September 1872; the two most recent cyclones occurred on the 17th-18th October 1909, and the 24th September 1919. These storms are of much longer duration than the ordinary nor'-wester, and much more severe. Usually they are accompanied by tidal waves. Both the storms themselves and the tidal waves cause much loss of life and damage to houses, crops and cattle, as well as to the forests. (See paragraph 49.)



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### Water-Supply.

21. Throughout the Sundarbans, the supply of drinking water is a very difficult problem. Numerous tanks have been dug by the District Boards, the Union Boards, local *zamindars* and the tenants themselves. Unfortunately, many of these tanks are failures, and they contain salt-water instead of fresh-water. Towards the end of the dry season, there is generally a fresh-water scarcity in the villages surrounding the forests, and the villagers frequently have to be content with either dirty, or slightly saline drinking water. Some of the Forest Revenue Stations have tanks attached to them, which have been constructed by the department; none of them are suitable for drinking purposes throughout the year, but some are usable for cooking purposes during the dry season. The following is a list of these tanks:—

- (1) *Suitable for drinking during the rains, and for cooking purposes only during the dry season.*—Sarankhola (near site of the old station), Nalkora, Namkhana, and Shikerpore.
- (2) *Suitable for cooking purposes only throughout the year.*—Dhangmari and Cassiabad.
- (3) *Suitable for cooking purposes during the rains.*—Supoti, Cobaduk and Rampura.
- (4) *Saline and unusable throughout the year.*—Nalianala (being eroded by the river), Burigoalni and Koikhali.

22. Tanks are more likely to be successful if dug in sandy soil and made circular in shape: sandy soil being more friable than clay, underground channels or leaks are less likely to form, and the circular shape gives a wider width of embankment, or encloses the maximum collecting area for the rain. The deepest part of the tank should be in the middle, and the bed of the tank should gradually slope upwards towards the sides. It is better to dig a tank gradually by digging down about a foot every year, in order that the salt, which rises to the surface of the earth in the dry season, may be scraped off and thrown outside the *bund*. The tank should not be dug too deep; in the vicinity of the forests, it is seldom possible to dig more than about 6 feet below the ground level without letting in the salt-water from the outside. If a tank is salt, it is often possible to sweeten it by digging a trench around the outside about 6 feet deep and 4 feet wide, filling this trench with sand, and emptying out the salt-water with a syphon at the end of the next dry season or at the beginning of the rains.

23. Drinking water for the forest staff working within the forests, is obtained from the nearest suitable tanks in the inhabited areas; the water is transported in special boats fitted with galvanised iron containers. The woodcutters and fishermen take their water-supply down to the forest with them in their boats; they store it in large earthenware pitchers or *jalas*. Occasionally, if staying in the forests for some time, they obtain a fresh supply of drinking water by digging holes in the sand on the sea-face. During the rains, the water in the Passar river is quite fresh, and the woodcutters, and sometimes the forest staff, replenish their supply of drinking water from it at low tide. This practice largely accounts for the prevalence of chronic diarrhœa amongst the woodcutters and the staff during the rains; to prevent this, river water should be treated with alum to clear it of sediment, and should be well boiled before use.

24. During recent years, several tube wells have been sunk in various places in the Khulna and 24-Parganas districts. In the Khulna district, 51 tube wells have been sunk; of these 41 have proved successful, one a partial success, and 9 have been failures. Five more are under construction. The successes have been mostly in the northern part of the district, the wells in the vicinity of the forests have proved failures: borings have been made at Bajua, Chunkuri, Jalma and Rayanda, but sweet water has not been obtained. Around Bardal, the wells have been successful, but those sunk near Assasuni have proved unsuccessful, except for one in Assasuni itself, which is only a little saline. The depths to which these wells have been sunk vary from 60 to 190 feet, and their cost varies from about Rs. 270 at 60 feet to Rs. 800 at 190 feet.

In the mufussal of the 24-Parganas district, fewer wells have been dug, but the borings are much deeper, and though more expensive, they are all successful. Fresh-water wells have been sunk by the District Board at Kakdwip on the Muriganga,

*Water supply*

and at half a dozen places in the Sandeshkhali thana, including one at Sandeshkhali village itself, which is quite handy for Rampura Forest Station. The shallowest well is the one at Kakdwip, which is 379 feet deep; the deepest is the one at Sandeshkhali, which is about 550 feet deep. The cost of the well at Kakdwip was Rs. 2,225, and that at Sandeshkhali cost Rs. 4,672. In addition, the Eastern Bengal Railway have sunk a tube well at Canning for their own use. In the firmer subsoil of the older delta formation of the 24-Parganas district, the probability is that sweet water could be tapped at reasonable depths near the forest boundary, but the success or failure of a well depends mostly upon the relative positions of the clay and sandstone or sandy strata.

### Distribution and Area.

25. **Reserved Forests.**—The reserved forests form a compact block along the south of the Bagerhat, Khulna, Satkhira and Basirhat civil subdivisions; they are bounded by the cultivated lands on the north, the Baleswar river on the east, the sea on the south, and the Matla and Bidya rivers on the west. There are no cultivated areas within the forest, nor are there any isolated patches of reserve within the cultivation.

26. **Protected Forests.**—The protected forests lie within the Alipore and Diamond Harbour subdivisions of the 24-Parganas district. Those within the Alipore subdivision, between the Matla and the Thakuran rivers, form a compact block between the cultivated lands and the sea; further west, in the Diamond Harbour subdivision, protected areas consist of odd peninsulars and islands, mostly near the sea coast, which still remain uncolonized. There is no protected forest west of the Muriganga or Channel Creek.

27. **Leased Lands.**—There are also several odd blocks of land in the 24-Parganas district, still containing forest, which have been leased out to private persons, but which have not yet been cleared. Government still holds the proprietary right to the forest produce on these lands, and the Forest Department is entrusted with the collection of royalties on any timber, fuel or minor produce exported from them.

28. **Distribution.**—The prescriptions of this plan divide the division into six forest ranges; the following statement gives their areas as computed for this plan, and their distribution:—

Range.	Civil subdivision.	Land.	Char.	Water.		Total.
				Small <i>khals</i> and creeks.	Large <i>khals</i> , rivers and estuaries.	
		Square miles.	Square miles.	Square miles.	Square miles.	Square miles.
Reserved Forests:—						
Sarankhola ..	Bagerhat ..	278.0	16.1	8.8	121.4	424.3
Chandpai ..	Do. ..	281.5	6.0	8.3	118.2	451.8
	Khulna ..	35.2	1.7	.9		
Khulna ..	Do. ..	560.4	9.7	16.6	213.4	800.1
Satkhira ..	Satkhira ..	427.8	16.6	16.5	179.4	640.3
Basirhat ..	Basirhat ..	648.0	18.5	29.6	301.9	998.0 2316
	Total ..	2,230.9	68.6	80.7	934.3	3,314.5
Protected Forests:—						
Namkhana ..	Alipore ..	185.0	14.5	7.5	331.4	638.3
	Diamond Harbour	56.9	41.4	1.6		
	Total ..	241.9	55.9	9.1	331.4	638.3
	Grand Total ..	2,472.8	124.5	89.8	1,265.7	3,952.8

NOTE.—The explanation of the terms "land," "char," "small *khals* and creeks," and "large *khals*, rivers, and estuaries" will be found in paragraph 8 of Chapter I, Part II. A similar statement, with the areas given in acres, will be found at the end of Appendix VIII.

The leased lands still remaining under forest consist of partially cleared plots, and uncleared strips of forest which have been left between the river and the embankments. It is not practicable to make a survey of these odd patches, or to record their areas.

### State of the Boundaries.

The boundaries of the Government forests are mostly natural ones formed by creeks, rivers, estuaries and the sea.

29. **Reserved forests.**—Around the reserved forests, the length of natural boundaries is 331·3 miles, including 39·1 miles of the boundary between the reserved and protected forests, whereas the artificial boundaries amount only to 2·8 miles; consequently, the expenditure required for the upkeep of boundaries is very small. The artificial boundaries are as follows:—

- (1) Between the Bhola river and the Bogi *khal*—2,530 yards demarcated by wooden pillars, and an artificial channel navigable by small boats at at high tide.
- (2) Around a small plot on the forest side of Chachan *gang*, near Chandpai Revenue Station—1,375 yards demarcated by wooden boundary pillars. (Recently, for the convenience of straightening the boundary, it was proposed to reserve this small parcel of cultivation, but the cost of acquisition was fixed at Rs. 17,480-4 for 60·84 acres; this large expenditure was not considered justified.)
- (3) Between Dhaji *khali* and Mir *gang*—829\* yards demarcated by an artificial channel and wooden boundary pillars. (The channel has altered its course slightly towards the forest side, and the pillars should be taken as the authentic boundary.)
- (4) Between the Kalindri river and Madar *gang*, demarcating the small piece of reserve which forms the compound of Koikhali Revenue Station—281\* yards, demarcated by two wooden boundary pillars.

In addition, the small boundary *khals* are silting up, and will soon need replacing by artificial boundaries, in the following places:—

The Ladobi *khal*, between the Dhangmari *khal* and the Bhadra *gang*.

The Chunkuri *khal*, between the Chunkuri *gang* and Mir *gang*.

The Gola *khali*, between the Dhaji *khal* and Madar *gang*. Recently, the local *zemindar*, according to the terms of his lease, has been made to erect concrete boundary pillars to demarcate the course of this *khal*.

The Singlagokhali *khal*, near Cobadak Revenue Station: the course of this *khal* has been marked temporarily by wooden pillars on alternate sides of the *khal*.

The Kuriakati, Jhinga *khal* or Sagun *khali*, between the Kalindri and Raimangal rivers.

30. **Protected forests.**—The boundaries of the protected forests consist mostly of natural water-courses and the sea, but there are one or two peninsulars of forests, whose boundaries are demarcated by *bunds* or dykes. The length of natural boundaries is 256·6 miles, including the common boundary between the reserved and protected forests. The length of artificial boundaries is 6·4 miles, made up as follows:—

	Yards.
Between the Dhahal <i>khal</i> and Bidya river (also demarcated by concrete boundary pillars) .. .. .	722*
From Jagadal <i>gang</i> to the Saptarmukhi .. .. .	3,362
From Habilla Creek to the Saptarmukhi .. .. .	1,804
From Chilapara <i>khal</i> to the Sahebkhali <i>khal</i> (C Plot, Reserved portion) .. .. .	1,276
Across Mahisani Island .. .. .	4,180
Total .. .. .	11,344

The lengths of boundaries given in this chapter were obtained by computation from the 1 inch sheets of the 1905-1908 survey, except for the figures marked\*, which are those given in the boundary notifications in force.

### Legal Position.

**31. Reserved forests.**—The whole of the reserves within the Khulna district were declared reserved in a notification, dated the 23rd January 1879; small disforestations were made by notifications in the years 1883, 1890 and 1910, and the boundaries of the present forests were renotified in notification No. 1439 For., dated the 8th February 1915. The forests in the Basirhat subdivision were made protected forests in 1878, and were constituted reserved forests 50 years later, by notification No. 15340 For., dated the 9th August 1928.

**32. Protected forests.**—The whole of the existing Government forest in the 24-Parganas district, was declared protected in a notification, dated the 7th December 1878; subsequently, much of the original area included in this notification has been disforested and leased out for cultivation. The boundaries of the remaining protected forest were renotified under notification No. 4457 For., dated the 9th April 1926. Recently this notification has been superseded by notification No. 10523 For., dated the 9th August 1929, which revises the boundaries so as to exclude the recently reserved forests of the Basirhat subdivision, and a recently colonized area in Mahisani Island. The rules regarding the control of the Protected Forests, have been promulgated under a notification, dated the 13th January 1880, and notification No. 2819 For., dated the 8th November 1906; under these rules, the clearing of land, and the cutting and export of forest produce without permit and payment of royalty, are prohibited; hunting is also controlled (*see* paragraph 35). The control over these forests is, therefore, almost as complete as that over the reserve. Changes in the royalty rates must be made by notifications issued by the local Government: the current rates have been published under notification No. 1888 For., dated the 16th February 1925. The following species have been reserved under section 29(a) of the Indian Forest Act of 1878, namely, *sundri* (*Heritiera minor*) and *passur* (*Carapa moluccensis*), *vide* notification No. 1839 T.—R., dated the 25th August 1906. Since their reservation, no passes have been issued for cutting these species in the Protected Forests. The cutting of *keora* (*Sonneratia apetala*), *kankra* (*Bruguiera gymnorrhiza*), and *amur* (*Amoora cucullata*) was also stopped about the same time; although these species appear to have been controlled in the same way as *sundri* and *passur*, no formal notifications for their reservation appear to have been issued.

**33. Leased lands.**—Practically all the uncleared forests remaining on lands which have been leased out for cultivation, are on lots which have been leased under the rules published by the Bengal Government in a notification, dated the 12th November 1879; they may be found in a publication issued by the Board of Revenue in May 1880, entitled "Rules for the Lease of Waste Lands in Bengal." Under rule XII of the terms of these leases, Government retains the proprietary right to the wood and timber on these lands; proprietors may cut as much as they wish for clearing the land, or for their own use within the lot without payment of any fee, but they, or the purchasers, have to pay the notified royalty rates and take out a permit for any timber exported out of the lot. The royalty rates, now in force, were published under notification No. 1889 For., dated the 16th February 1925. Proprietors of lands leased under rules made prior to 1879, may export forest produce free of charge from their lots; but, in order to ensure the transit control, rules II and VI of the transit rules prescribe that such produce must be covered by a "Right of Way Pass" issued on payment of a small fee at the notified rate.

**34. Transit of forest Produce through the waterways of the Sundarbans.**—Under notification No. 2821 For., dated the 8th November 1906, issued under sections 31 and 41 of the old Indian Forest Act (VII of 1878), no person can transport forest produce through the waterways of the Sundarbans without a pass of some kind from the Forest Department, and only in boats measured and registered under the rules. Without this notification, the control of theft from the Sundarbans forests would be impossible.

**35. Drift rules.**—The drift rules for the Sundarbans were published in a notification, dated the 16th February 1881; they do not extend to the Hooghly river, which is under the control of the Port of Calcutta.

**Hunting and shooting** are controlled by the rules in notification No. 839 For., dated the 23rd January 1915, and its various amendments; both the reserved and protected forests are included in Class II for the purpose of rule 3 in notification No. 839 (see notification No. 6833 For., dated the 29th August 1923.)

### Rights and Concessions.

36. There are no rights of any kind in either the Reserved or Protected Forests, though no restriction has ever been made with regard to the fishing in the rivers and creeks interlacing the forests. Timber thieves and poachers very often disguise themselves as fishermen, when on trips to the forests for illicit purposes; this practice makes detection very difficult, especially as the stolen timber or deer flesh is carried out in boats under the cover of night. When on their trips, the genuine fishermen obtain their fuel from the forest and, whenever they consider themselves safe from detection, cut trees, *goran* sticks and *golpatta* leaves in the forests for repairing their boats, and making or repairing their oars, paddles, shelters, etc.; occasionally, they steal *goran* bark for tanning their nets. For these reasons, in 1923, the Forest Department recommended that the fishing in the Sundarbans should be controlled by the issue of passes on payment of a small fee; the Local Government did not accept these recommendations, holding that it was their policy to avoid taxation of fishermen wherever possible, and that they were doubtful of the advantage which would accrue from their control in the Sundarbans. At the time of writing, the question of regulating the fishing is again being considered by Government. Besides the assistance to the control of the forests, it has been recognised that some sort of regulation is also desirable for the conservation of the fish. It is interesting to note that the Burma Government leases out the fishing rights in the rivers and creeks of the Myaungmya Forest Division in the Irrawaddi Delta.

37. Every cold season, deep sea fishermen from Chittagong sail across the Bay of Bengal in small open boats, and settle on the sandy shores around Manikdea *khal* in Dubla Island; this has been the custom for many years past. A few Mughls from the Barisal Sundarbans often join the settlement. After making a catch, they dry their fish in the sun on the sandy shore. The Forest Department charges a small fee per head for this privilege, and in return, besides being allowed to dry their fish on the shore, they are permitted to build temporary sheds for themselves, to cut firewood and *goran* bark for tanning their nets, etc. The fee being charged at present, is Re. 1 for each settler. The number of fishermen coming to settle each year varies between 1,500 and 2,500.

## CHAPTER II.

## THE FOREST.

## Composition and Condition of the Crop.

38. **General description.**—The crop consists of species peculiar to tidal swamps, whose physiology is adapted to a close clayey soil, and the alternate flooding at high tide and drainage during the ebb with salt or slightly brackish water. Trees requiring ordinary land conditions, such as *Eugenia*, *Diospyros*, and *Ficus* species, are found only on the sandy maidans of the sea-face, and here and there within the forests, on small artificially raised plots on and around the ruins of old habitations and salt kilns. One or two trees, such as *Pongamia glabra* and *Thespesia populnea*, are found both on the sandy maidans and occasionally on the higher tidal land. The quality and density of the forest is best in the fresh-water areas to the north-east; the forests become poorer and more open, as one proceeds towards the sea or towards the west. Broadly speaking, the forests may be divided into three zones according to the degree of salinity of the water in the surrounding rivers, namely—The comparatively fresh-water area, consisting of all forests to the north and east of an imaginary transverse line, drawn from the Cobadak Forest Station on the northern boundary to the mouth of the Katka *khal* on the sea-face; the moderately salt-water area, to the west of this transverse line, but east of the Raimangal river; and the salt-water area, to the west of the Raimangal river.

39. **The fresh-water forests.**—During the rainy season, the rivers and creeks in this area are either quite fresh or only slightly saline, and the soil gets a good coating of fresh silt each year. The predominant tree is *sundri* (*Heritiera minor*), a gregarious shade bearer yielding a heavy crop. It is mixed with varying quantities of *gengwa* (*Excocaria Agallocha*), the proportion of which increases from about 20 per cent. in the north and eastern areas, to about 50 per cent. as one approaches the transverse line, except in the forests between the Passar and Arpangasia rivers, where the proportion of *sundri* still remains high, and that of *gengwa* remains comparatively low, even in the moderately salt-water areas. The species next in importance *passur* (*Carapa moluccensis*), which is frequently associated with *kankra* (*Bruguiera gymnorhiza*); these two trees are not generally gregarious, but are commonly found in the damper places throughout the forest: they are particularly important in the low areas of the northern forests, between the Passar river and the Shakbaria *khal*, where pure patches of each species are often found. Species common on new channels, banks of rivers and streams, and in the *bils* are *keora* (*Sonneratia apetala*), *baen* (*Avicennia officinalis*), *ora* (*Sonneratia acida*), and *golpatta* (*Nipa fruticans*), a palm with underground stem; towards the transverse dividing line, *khalshu* (*Ægiceras majus*), *kirpa* (*Lumnitzera racemosa*) and *dhundal* (*Carapa obovata*), begin to appear on the banks of *khals*, and the latter is frequently found in the *bils*. Common species found as an understory beneath the *sundri*, are *singra* (*Cynometra ramiflora*) on comparatively dry soils, and *amur* (*Amoora cucullata*) on the moister soils; towards the more saline areas, these species, though still common, become less plentiful, and *goran* (*Ceriops Roxburghiana*), becomes the principal undercrop.

40. The best *sundri* forest is found on the moderately moist land well drained at each ebb-tide, between the dry land on the banks of larger streams and the *bil* areas; except where erosion is occurring, one seldom sees good quality *sundri* without penetrating into the interior of the forest; on the dry zones near the streams, it is invariably of poor growth. The same remarks apply to the *gengwa* and *passur*; but as a species, *gengwa* is more tolerant of drier soils, and *passur* is more tolerant of the damper *bil* areas; consequently, in the inferior growth on the banks of *khals*, the proportion of *gengwa* is greater, and in the damper areas, the proportion of *passur* is greater. *Kankra* is a tree which prefers a low soil surface, but it reaches its best height growth on the outskirts of the *bils* and not inside them. The best patches of forests are found in the northern part of Lot No. 7 in Compartment 1, and in the interior of Compartment

27, where *sundri* reaches a height growth of 70 feet and a diameter of 16 inches at breast height. North and east of a line drawn from the Bhadra, *via* the Charputia *khal* to the Dudmukhi *gang*, the height growth in the interior of the islands is 50 feet and over. South and west of this line, the height growth gradually deteriorates, until on the boundary of the moderately salt-water zone, it varies between 30 and 40 feet. Generally speaking, the stocking is dense and regeneration is satisfactorily throughout the fresh-water area. In the forests of over 50 feet height growth, the enumerations for this plan have shown that there is an average of 515 apparently sound trees of over 3 inches in diameter per acre, consisting of 395 *sundri*, 91 *gengwa*, and 29 of other species; in the forests of 35 to 50 feet height growth, there is an average of 505 sound trees of over 3 inches in diameter per acre, of which 318 are *sundri*, 130 are *gengwa*, and 57 are of other species. The deficiencies of the older age classes, and the results of overcutting of certain species, are described in Chapter V of Part I, and in Chapter II of Part II.)

41. The forests are much freer of weedy undergrowth than most land forests, and generally the moderately moist areas, which carry the best forest growth, are free from weeds of any description. Most weeds are found growing on the dry zones near the banks of the larger streams, or on immoderately wet *bil* areas; but there are areas especially in the north, where weeds, such as *Hibiscus* and *Pandanus*, grow prolifically in the moderately moist forest, and where they seriously obstruct regeneration and retard the growth of older trees by competing with their roots. The most important weeds are *bhola* (*Hibiscus tiliaceus*), *kewa-kanta* (*Pandanus odoratissimus*), *hodo* or *tiger fern* (*Acrostichum aureum*), *hantal* (*Phœnix paludosa*), *hargoza* (*Acanthus ilicifolius*) and *sundri-lota* (*Brownlowia lanceolata*). *Bhola* is a half scrambling, half climbing type of plant, which is found in dense impenetrable patches in dryish, or moderately moist areas around the Bogi *khal*, and in the northern part of the forests between the Bhola and the Chachan, and between the Passar and the Bhadra. *Kewa-kanta* is a prickly weed of scrambling habit; it is also found in dryish or moderately moist soils; it is common throughout the fresh-water forests, especially on dry ground near the banks of *khals*. It is more tolerant of shade than most weeds, and often forms a thick jungle under fairly good overhead cover. Owing to its prickly leaves, patches of *kewa-kanta* are very difficult to traverse. *Tiger fern* is a weed of damper soils: when growing sparsely under good overhead cover, it does little damage, but in the *bil* areas of the northern forests between the Bhadra and the Shakbaria, it grows in dense patches, totally excluding all tree growth. *Hantal* is found in patches near the banks of *khals*, generally on the driest land, which is flooded at high tide only on rare occasions during the rains. *Hargoza* and *sundri-lota* are not very important: the former is a common weed on new *chars* generally associated with *keora*, and the latter is found, fairly frequently, growing below high tide level on the banks of *khals*.

42. **The moderately salt-water forests.**—This zone consists of the forests near the sea-face, and around the semi-moribund rivers, in which the water is somewhat less saline in the rains than it is in the dry season. As a rule, the surface soil is harder and, containing less humus, it is lighter in colour than that of the fresh-water forest. The predominant crop consists of *gengwa* (*Excoecaria Agallocha*), mixed with varying proportions of *sundri* (*Heritiera minor*), growing over a fairly dense jungle of *goran* (*Ceriops Roxburghiana*). Near the boundary of the fresh-water forests, *sundri* is an important tree in the mixture, but further west and south, its proportion gradually dwindles, until, near the Raimangal river, it becomes comparatively scarce. The *sundri* is of small size, but being of slower growth than that of the fresh-water forests, the percentage of heartwood is greater and the wood is closer grained; this type of tree is locally called *pukka sundri*. *Passur* (*Carapa moluccensis*), is more frequently met with in these forests than in the fresh-water areas; associated with *kankra* (*Brugueira gymnorhiza*), and *baen* (*Avicennia officinalis*), it is particularly plentiful in the northern forests between the Kalindri and the Arpangasia, where the ground level is generally low. Near the fresh-water forests, species common on new *chars*, banks of streams and in the *bils* are *keora* (*Sonneratia apetala*), *baen* (*Avicennia officinalis*), *golpatta* (*Nipa fruticans*), *khalshi* (*Agiceras majus*) *kripa* (*Lumnitzera racemosa*), *dhundal* (*Carapa obovata*), *passur* (*Carapa moluccensis*), *kankra* (*Brugueira gymnorhiza*), and *goria* (*Kandelia Rheedii*). Towards the more saline areas of the south-west, *keora*, *baen* and *golpatta* become comparatively scarce; in their place, *garjan* (*Rhizophora conjugata*) begins to appear, and *goria*, *kankra*, *dhundal*, and *passur* become more plentiful. *Amur* (*Amoora cucullata*), is fairly common beneath the better quality forests



towards the north and east; *singra* (*Cynometra ramiflora*) is comparatively rare. *Tora* or *satali-gach* (*Ægialitis rotundifolia*) is frequently found near the sea-face or growing near the banks of the larger streams in the west, forming patches of thick jungle, which, from a distance, appear not unlike *goran*.

43. East of a diagonal line drawn from the northern part of Churkuni gang to the mouth of the Murjattah, the forests are fairly well stocked, and *sundri* forms anything between 10 to 70 per cent. of the overcrop. The average stocking consists of 396\* sound trees of 3 inches diameter and over per acre consisting of 172 *sundri*, 201 *gengwa* and 23 other species. The stocking of *goran* of 1 inch diameter and over is about 985\* per acre. Further west, both the stocking and quality depreciate: low damp areas, locally called *gengwa mathal*, containing nothing but sparsely spaced *gengwa* of poor quality are frequent, and the main crop consists of fairly widely spaced *gengwa* of 25 feet to 35 feet height growth, growing over dense *goran* of good quality, with here and there taller and denser clumps of pure *sundri* growth. In the forests west of the Madar and Faringhi gangs, and of the southern part of the Malancha river, the quality and stocking further depreciate. On the drier soils, there are many large stretches of jungle which contain little except scrub *goran* 4 to 6 feet high growing under stunted *gengwa* of from 10 to 20 feet in height.

44. Other than *goran*, and the other woody species previously mentioned, undergrowth in these forests is comparatively rare. Some *tiger fern* (*Acrostichum aureum*) occurs under the better types of forest associated with *sundri*, *sundri-lota* (*Brownlowia lanceolata*) is fairly common on the banks of *khals*, and *hargoza* (*Acanthus ilicifolius*) is found here and there on fresh *chars*. *Hantal* (*Phœnix paludosa*) occurs throughout the zone on the driest soils, generally near the banks of the larger streams.

*Delta* 45. **The salt-water forests.** West of the Raimangal river, the rivers remain practically sea-salt throughout the year. The soil is hard, and the *bil* areas are large. The forests consist mainly of sparsely spaced *gengwa* of 10 to 20 feet height growth over dense *goran*, interspersed with dense patches of *hantal* on the drier soils. The two *Carapa* species, *dhundal* and *passur*, and an occasional *kankra* (*Bruguiera gymnorhiza*), occur sporadically throughout the area, intermixed with the *gengwa*. Common species on the banks of streams and *khals*, on new *chars* and in the *bils*, are *garjan* (*Rhizophora conjugata*), *goria* (*Kandelia Rheedii*), *white baen* (*Avicennia alba*), *kankra*, *dhundal*, *passur* and *math goran* (*Ceriops Candolleana*); *keora* (*Sonneratia apetala*), is found only occasionally, and when found, is low and spreading in habit; *kripa* (*Lumnitzera racemosa*) also occurs in places. On the new *chars*, gregarious clumps of *white baen* of 15 to 25 feet height growth are the most common crop. Unlike the fresh-water forests, in the salt-water zone the best growth is found around the banks of the smaller streams and creeks. The *bil* areas are either blank, or carry only a sparse crop of the species mentioned. On the drier soils of the interior, the vegetation is often of the type known locally as *goran math*, namely, dwarf scrubby *goran* or *math goran* without the usual admixture of stunted *gengwa*. Similar *math* of *white baen* is common, and occasionally such scrub consists of *Tora* (*Ægialitis rotundifolia*).

46. East of the Matla river, about 40 per cent. of the area is covered with better quality forest, where the *gengwa* attains a height of 20 to 35 feet, and the *goran* undergrowth is of good quality. Towards the north, these forests contain a fair proportion of *pukka sundri* and *passur* of pole size: towards the south, there is still a fair amount of *sundri*, but the other *Carapa*, *dhundal*, mostly takes the place of "*passur*."

47. West of the Matla river, the main forest consists, almost invariably, of either *gengwa* and *goran* scrub or *hantal* jungle; most of the exploitable trees are concentrated around the banks of the small *khals*, or on the new *chars*. *Goran math* and *white baen math* become more common, and large salty stretches occur devoid of growth of any description. On the new islands and *chars* in the Thakuran, Saptamukhi and Muriganga rivers, the crop is of better quality; it consists predominantly of *white baen*, often mixed with *keora*, or the other *baen* (*Avicennia officinalis*) and an understory of good quality *goran*. The small area of forest on the older land formations on the eastern side of the Muriganga, is also of slightly better quality than the rest of the forest west of the Matla, probably because the stream of the Hooghly makes the water slightly less saline during the rains.

\* These figures are the average results of the linear enumerations made in Compartments Nos. 7, 8, 9, 17, 18, 19, 41, 42, 45, 46 and 47.

48. *Hargoza* (*Acanthus ilicifolius*) often occurs on the new *chars*, associated with *white baen* and *keora*; *sundri-lota* (*Brownlowia lanceolata*) is occasionally found on the banks of *khals* east of the Matla; and grass occurs on sandy stretches near the sea-face. Other than these species and *hantal*, there are no non-woody species of any importance, west of the Raimangal river.

A list of common species found in the Sundarbans, giving their vernacular and botanical names, will be found in Appendix I.

### Injuries to which the Crop is Liable.

The principal sources of damage to the crop are wind, erosion, animals, and unregulated felling by permit-holders; the effects of the latter are fully discussed in Chapter V.

49. **Wind.**—Sporadic windfalls are caused by the storms of April and June, and September and October; also trees exposed to the south-west monsoon on the sea-face are stunted, and have either bent or broken tops. The most serious damage is caused by the occasional cyclones which sweep over the forests. The cyclone of 1909 reached the coastal forests at about midnight on the 16th of October, and at about 4 a.m. on the 17th, it reached the northern boundary of the forests, where it continued to rage until about 10 p.m., before passing away to the north. The damage was worst in the north-eastern part of the reserve, where large areas of the best *sundri* forest were levelled to the ground. Tops were broken and branches were torn off throughout the forest. During the height of the storm, the wind reached a speed of about 77 miles per hour and came from the east. The worst damage occurred between the Bhadra gang and the Passar river, where no fellings had been made for sometime; on the other hand, in many of the recently thinned areas between the northern part of the Sela and the Passar, which happened to be sheltered by high pole forest on the east, there was surprisingly little damage. Nearly all the forest revenue stations in the Khulna district, were either blown down or unroofed. Outside the forests, much loss of life and cattle was caused by the accompanying tidal wave, which swept over the more southerly cultivated areas, particularly in the Sarankhola thana.

The cyclone of 1919 reached the coast of the Khulna district at about 9 a.m. on September the 24th and reached the northern boundary of the forests at about 4 p.m. where it continued to rage until about midnight, before passing away. The wind first blew from the east, and then, after a short cessation, recommenced from the west. The cyclone was of about half the duration of that of 1909, and the damage caused was not so great. The damage to the forest was again most severe between the Passar and the Bhadra; Compartment 29 and parts of Compartment 30 suffered most. In addition to the damage to the forests, Dhangmari Forest Station buildings were totally destroyed, and the Baniakhali Station building, the Station Officer's quarters at Cassiabad, and Tambulbania Station building were blown down; other forest stations in the Khulna district had their roofs blown off, or were otherwise damaged. Of the forest fleet, 6 accommodation boats, 3 jolly boats and 15 *dinghies* were lost. Rupees 25,000 was sanctioned for the replacement of the boats and *dinghies*, and for the reconstruction or repair of the destroyed or damaged departmental buildings. There were no casualties amongst the forest staff, but, mainly due to the tidal wave, 432 deaths were caused in the Khulna district, and the cattle mortality was reported at 28,029. Free permits for *golpatta* and house-posts were granted to homeless people for the reconstruction of their houses; the royalty value of these grants amounted to Rs. 15,409.

50. **Erosion.**—Erosion is continually occurring in places along the banks of the larger streams and rivers, and on the sea-face. In the rivers, the trees mostly sink down into the river-beds and disappear; on the sea-face, their roots are laid bare by the scour of the waves, or smothered by encroaching sand. Every year, large quantities of timber and *golpatta* are lost by erosion, more than one at first realises.

51. **Animals.**—Animals cause serious damage to regeneration and *golpatta* in the moderately salt-water forests, where *gengwa* is the predominant crop. Cheethal deer are the principal offenders, and their increasing numbers are becoming a serious menace. Their favourite foods are *keora* fruit and leaves, and grass, but if these are not available, they will consume young regeneration of *sundri*, *gengwa*, *amur*,

*golpatta*, and most other species excepting *goran*. Browsed down *gengwa* regeneration is a very common feature of the *gengwa* forests of from 30 to 35 feet height growth. They also chew the younger leaves of mature *golpatta* plants, and by continual attention in this way, eventually kill them. Besides *cheethal*, the only other type of deer found in the forests is barking deer; this animal is comparatively rare, and is found only in the more northern areas, east of the Sipsah river. Monkeys frequently kill off young *golpatta* regeneration by pulling up the plants, nibbling the young shoots and throwing them away. Pigs are fond of rooting up seeds and seedlings; but they are not so numerous as the *cheethal*; the damage they do is, therefore, not so extensive. During recent years, the number of pig appears to be increasing. Small mud crabs are suspected of being the cause of the lack of *keora* regeneration in the fenced-in sample plots, and are very probably responsible for holes found in the bases of *gengwa* trees in the more saline areas.

52. **Insects.**—Damage by insects is not very serious. The larvæ of the moth, *Hymenoptychis sordida*, destroy most of the *sundri* fruits each year, but there is always sufficient left for regeneration purposes. *Hypsipyla robusta* is a similar pest found in the *passur* seeds. Each year, an unknown insect makes holes in practically every leaf of *baen* (*Avicennia officinalis*), and a boring beetle does a certain amount of damage to the heartwood of both species of *goran* and *dhundal*.

53. **Other natural causes.**—*Polypodium quercifolia* and *P. inciodes* are common epiphytes in the eastern forests, but do not appear to interfere seriously with the growth of the trees. In Compartments 47 and 48, *Loranthus longiflorus* is a common epiphyte on the unhealthy and stag-headed *sundri* and *passur*, and appears to do a certain amount of damage. Climbers are comparatively scarce, and the damage they do is negligible. On the higher ground near the banks of *khals* in the fresh-water forests, *Derris uliginosa* and *Sarcolobus globosus* are common. On high sandy patches near the sea-face, and on the remains of salt *golas* and other ruins, *Entada scandens* and *Derris sinuata* are generally present. On the true delta soils, the prickly creeper, *Mezoneurum cucullatum* is met with occasionally in the fresh-water areas; but, as a rule, the forests in the interior of the islands are remarkably free from creeper growth. Occasionally, within the *sundri* forests, one meets small circles of dead trees, suggestive of a root fungus. Lightning is also sometimes responsible for patches of dead trees; an instance of this may be seen in Sample Plot No. 1 in *Koira gang*, where one flash of lightning killed 3 trees outright, and another 12 were either killed right down to the base, or to within 10 to 18 feet of the base.

54. **Theft.**—Petty thefts of *sundri* or other valuable species frequently occur in the vicinity of the boundaries, but thefts on a large scale are, happily, quite rare.

## CHAPTER III.

## UTILISATION OF THE PRODUCE.

## Agricultural Customs and Wants of the Neighbouring Population.

55. Practically the only crop that is grown on the recently cleared lands surrounding the forest, is *aman* rice, which is sown in May or June, transplanted between the middle of July and the middle of September, and reaped in December or January. The growth of winter rice is found further north, where *aus* crops are grown on the higher lands, and *boro* crops in the *bil* areas. Occasionally, jute is grown in the northern part of the Khulna district; it is quite a common crop in the Jessore district. Most Sundarbans cultivators grow a certain amount of vegetables, fruit and occasionally tobacco for their own use. These are grown on artificially raised plots, or on the *bunds* surrounding their homesteads. The fruit trees are usually palms, such as *Cocos nucifera*, *Phoenix sylvestris* and *Areca catechu*, but it is not unusual to see a mango tree, or a jack fruit (*Artocarpus integrifolia*); an inferior kind of plantain is also very popular.

56. The more important kinds of forest produce which the local population need for their use are:—Timber for boats, small poles for house-posts and rafters, *golpatta* leaves for thatching, *nal* grass for making into matting for walls, *goran* sticks for forming the core of mud walls and for fencing and fuel. In better class houses, sawn timber (mostly *baen*) is used, and corrugated iron, instead of thatch, is more popular for roofs. Hollow *baen* logs are used extensively for making drains or sluices through the *bunds*. As *sundri* and *passur* have not been available for local use during the last 25 years, the favourite timbers for cheap house-posts are *dhundal* and *goran*. *Kutchra* rafters are generally made of the same two species or of *hantal* stems. The most important need of the local people is that of boats, which are the only means of transport, and without which, journeys of any distance cannot be made. Practically every family in the Sundarbans possesses a small *dinghy* or a boat; hundreds of small boats can be seen moored up against the banks of each local *hat* on market days. In former years, *sundri* was the most commonly used timber for boats. At the present time, the better types of boats are generally made of teak or *sal*, and inferior Sundarbans species are used for the cheaper kinds of small boats and *dinghies*: it is comparatively rare to see a local boat made of *sundri*. If the sale of *sundri* were allowed in the areas surrounding the forests, there is no doubt that this species would again become popular for boat building. Fuel is the next most important local need; the favourite kinds used for this purpose are *singra* and *baen*, but local people use almost anything that they are allowed to cut at fuel rate.

## Marketable Products.

57. **Timber and fuel.**—*Sundri* (*Heritiera minor*) in the form of timber and poles is the most important marketable product from the eastern Sundarbans forests. Its principle uses are house-posts, rafters, and masts, oar-handles and planking of boats. Each year the auction sales are monopolised by the *sundri* merchants from the Barsakati markets of Barisal. A certain amount of *sundri* fuel is consumed by Calcutta and Jessore, there is also a limited sale in Calcutta and Jessore for small poles, which are used mostly for making the hubs and axles of cart wheels. Other than this, very little *sundri* is used, at present, outside the Barisal district, although 25 years ago, it was in common use throughout the Khulna district. This contraction in the extent of the market is due very largely to the ingress of teak, *sal*, iron-wood, *jarul*, etc. The cheapness of water transport makes the localities around the Sundarbans more accessible for these foreign timbers, which can usually be obtained in larger sizes, and are more satisfactory for general constructional work and boat building. Other reasons for the contraction of the *sundri* market are due

to the past management; this is explained in Chapter V. Many wind-fallen trees of *sundri* sink beneath the mud, and become naturally seasoned; in a few years time, the heartwood of these trees very often takes a deeper red colour, and becomes extremely hard and durable; such timber is called *sundri jhara*, and is much sought after for axe-handles, and for uses where great hardness or durability is required. This sort of material may be compared to bog-oak. Unfortunately pieces of *sundri jhara* are generally small and very irregular in shape. Poles of *pukka sundri* are more valuable than similar sized poles of *sundri* of more rapid growth; the percentage of heartwood is greater, and they are more durable. *Sundri* buttresses are used extensively for oar blades.

The Barsakati markets take a wide variety of shapes for timber purposes. Generally, the minimum size is about 8 feet straight length, by 3 inches diameter at the small end; shorter, or crooked pieces of larger diameter are also taken. The minimum length of a large girth sound log for boat planking, is about 4 feet 6 inches or 5 feet. Often angular pieces of small girth are used for making ploughs. For axles and hubs of cart wheels, the Jessore market takes selected straight pieces of about 6 feet 9 inches length by 1 foot 2 inches girth, and the Calcutta market takes slightly larger poles, which average 7 feet long by 1 foot 4 inches girth. The average size of fuel pieces taken by the Calcutta and Jessore markets, is 6 feet 6 inches length by about 10 inches average girth; the minimum girth taken is about 5 inches.

58. *Gengwa* (*Excæcaria Agallocha*) is the next important marketable timber, which has come in demand very much in recent years for cheap box planking, matches and match boxes. Most of this demand comes from Calcutta, but a match factory started in Khulna a few years ago, and is still working. This species, owing to its lightness and the ease with which it is cut, is also used extensively for *jhools*, or steady-ing floats on the side of local boats, and *mallams*, or planks fixed above the gunwale for increasing the free-board. It is used extensively, also, for dunnage, both in large ocean-going craft, and in small boats taking out forest produce from the forests.

Logs and poles for matches, match boxes and box planking are exported in short billets of from 4 to 7 feet in length. Logs for matches and match boxes must have a minimum diameter of 6 inches and must not be fluted; 4 foot 6 inch lengths are used by most factories. Unfortunately, the supply of even these modest sizes is not nearly enough for the demand. Providing that they are straight, poles of a minimum diameter of 4 inches at the thin end are taken for box planking, but larger diameters fetch better prices. For dunnage in ocean-going vessels, small saplings of 1 inch to 1½ inches diameter and from 3½ feet to 7 feet in length, are utilised. *Jhools* and *mallams* are cut in longer lengths and to suit the size of the boat for which they are used.

59. *Keora* (*Sonneratia apetala*) is a large sized timber, for which there is a ready sale whenever it is put up for auction; formerly, it used to have an extensive sale in Calcutta for box planking; but during the currency of the last plan, like the *sundri*, it has been in the recuperating stage, and its sale has been limited to the *sundri* coupe for the year. Another large sized timber is *baen* (*Avicennia officinalis*), which has an extensive market for planking. Owing to unregulated felling, it has been much overcut, and probably *keora* will largely take its place for planking during the currency of this plan. Hollow *baen* boles are used by local people for constructing sluices through their *bunds*; other unsound pieces, of all shapes and sizes, are much in demand for fuel. Both *keora* and *baen* are utilised for planking in the largest sizes obtainable, but the minimum size of sound logs used for this purpose, is about 6 feet long by 6 inches minimum diameter.

60. *Passur* (*Carapa moluccensis*) is a deep red timber, which makes a durable house-post, and is suitable for general construction work. During the currency of the previous plan, its cutting was restricted; in former years, there was an extensive local sale for this species. Whenever obtained by local people, it is utilised down to very small billets and sizes for ornaments, axe-handles, etc.

61. *Dhundal* (*Carapa obovata*) is a similar timber to *passur*, but is obtainable only in small sizes, and, as a rule, is irregular in shape. It makes very durable house-posts, which have an extensive use in rural localities: it is generally cut in lengths of about 8 feet for this purpose. In Calcutta, this timber is used by one factory for pencils, and pen handles.

62. *Goran* (*Ceriops Roxburghiana*) has an extensive sale in Calcutta for firewood; its bark is also used for tannin, but not nearly so much as formerly. Throughout the Khulna, 24-Parganas, Barisal and Jessore districts, it has a market for small house-posts, cores of mud walls, and fencing; there is also a limited sale in the Chittagong and Noakhali districts on the east, and in the Midnapore district on the west. Poles and house-posts for the Calcutta market, average about  $10\frac{1}{4}$  feet long by 1.8 inches diameter at 3 feet from the thick end. Smaller lengths and sizes are taken for fencing posts. Fuel sticks for the Calcutta market, average 5 feet 4 inches long by 1.6 inches diameter at 3 feet from the thick end. *Chittas* for fencing cross bars, use in thatched roofs, cores of mud walls, etc., are cut in sizes averaging about 9 feet 8 inches long by 1 inch diameter at 3 feet from the thick end. *Math goran* (*Ceriops Candolleana*) is of stouter growth than the ordinary *goran* but has more taper. It is used for house-posts of small huts in Calcutta, and other western markets.

63. *Singra* (*Cynometra ramiflora*) is the most popular fuel in the Sundarbans; it is utilised for this purpose in all sizes and shapes down to brushwood. *Amur* (*Amoora cucullata*) is much sought after for small house-posts, paddles and *hookah* stems; the cutting of this species was restricted to the annual *sundri* coupe during the last plan; an increase in its export is expected, therefore, under the treatment prescribed in this plan.

Practically every other species is used as fuel if other kinds are not available, and *Rhizophoraceae* such as *kankra*, *garjan* and *goria* are used for cheap rafters, scantlings, and occasionally house-posts.

64. **Minor produce.**—The leaves of *golpatta* (*Nipa fruticans*) are much in demand for thatching and *kutch*a fencing; it is used extensively in practically all places to which transport from the Sundarbans is reasonably cheap: the sale of these leaves yields about one-fifth of the revenue of the division. Before being stacked in the boats, the leaves are halved by being split down the rachis, and are used for thatching in this form. The Calcutta market takes small lengths of 5 to 6 feet, but other localities utilise the leaves in longer lengths of 8 to 12 feet. Purchasers coming from Chittagong and Noakhali strip off the leaflets, and do not utilise the rachis at all. A higher rate of royalty is charged for stripped off leaflets than for half leaves.

65. *Ullu grass* (*Saccharum cylindricum*) makes the most durable type of local thatching, but its supply is limited to the sandy *maidans* on the sea-face. *Nal grass* (*Arundo Karka*) is used extensively for making a matting locally called *dharma*, which is used for walls of houses, coverings of boats, and mats. There is a small demand for *hogla* (*Typha elephantina*), the split reeds of which are used in cheap fencing and walls; it is not very durable and seldom lasts more than one season. The stems of *hantal* (*Phœnix paludosa*) are used extensively in the construction of small huts as roof rafters and framework of the walls.

66. There is a great demand for *honey* and *wax* permits during the season: honey is used both for ordinary consumption, and as an ingredient in *kaviraji* medicines; the wax is exported mostly to Calcutta, where it is used by pharmaceutical works, cartridge and shot factories, and for making candles. *Jhongra* shells (*Cerithium telescopium*) are collected off the mud banks of the rivers and *khals*, for burning into lime for using with *pan*: the shells of an estuarine bivalve, *jhinook* (*Cyrena bengalensis*) are also quite common, and often collected for this purpose. Oyster beds of *kostura* (*Ostrea gryphoides*) are found, here and there, in the small *khals* of the salter localities, but their shells are not utilised to any extent.

### Markets.

67. Sundarbans forest products find their way to most parts of the surrounding districts, which are within reasonable transport distance by water; Calcutta, Midnapore, 24-Parganas, Khulna, Jessore, Barisal and parts of the Faridpur district are reached in this way. During the winter season, there is also a limited export across the Bay of Bengal to the Chittagong and Noakhali districts. The most important market for fuel and *golpatta* leaves is Calcutta, and the most important market for *sundri*, *baen* and *keora* timber, is the locality known as Barsakati in the Barisal district. Other than in Calcutta and Barsakati, the business in Sundarbans forest

products does not tend to concentrate into important centres, but is scattered about in small village distributing and sale markets throughout the surrounding country. The following is a list of the principal distributing and sale centres, starting from east to west :—

### Chittagong and Noakhali Districts.

During the winter season only :—*Goran* and stripped leaflets of *golpatta*.

#### Faridpur District.

Boalmari, on the Sarasia river :—*Sundri*, *passur* and *dhundal* poles.  
Ghagor, near Kotalipara police-station—*Sundri* poles and *golpatta* leaves.

#### Barisal District.

Swarupkati; Sohagdal, Kaurikhara, and Indirhat, on the Swarupkati river; Jhalokati on the Gajalia river; Kaukhali on the Kaukhali *khal*; Barsakati, Sutiakati, Baliari and other Barsakati villages :—*Sundri*, *baen* and *keora* timber, *goran* poles, *amur* poles, *singra* and *goran* fuel, and *golpatta* leaves; there is also a limited sale for shells at Jhalokati. The business in *amur* is concentrated at two villages, Srimantakati and Gatra in Kaukhali thana, and at Jhalokati, otherwise the produce specified can be obtained at any of the villages mentioned.

Nalbania and Parerhat on the Kacha river, Kadamtala and Perojpur on the Baleswar river, and Bhandaria reached by the Sialkati *nodi* from the Kacha river :—*Goran* poles, *singra* and *goran* fuel, and *golpatta* leaves.

Tushkhali on the Pona *bharani*, Shangrail, on the Shangrail *khal*, Matbaria and Sapleja on the Sapleja *khal*, and Chorduania on the Chorduania *khal* :—*Goran* poles, *goran* and *singra* fuel, and *golpatta* leaves. These markets are reached by crossing the Baleswar river. Most of the export to them is during the cold weather; at other seasons, it is not possible for boats to cross the Baleswar to Chorduania.

#### Jessore District.

The woodcutters generally sell *sundri* poles for cart axles direct to the consumers in the various villages, but there are one or two small markets, such as Bardia (off the Bhairab *via* the Kaliganga *khal*), where *sundri* poles, *dhundal* house-posts, and *goran* poles are sold.

#### Khulna District.

##### Bagerhat Subdivision.

Morrelganj on the Pangachi river :—*Baen* logs, *goran* poles, *singra* and other fuel, and *golpatta* leaves.

Bagerhat, on the old Bhairab or the Keora river (approached *via* Kachua Cut from the Baleswar), Rayenda on the Choddarashi *khal* in Sarankhola thana, and Rampal on the Mongla river :—*Goran* poles, *singra* and other fuel, and *golpatta* leaves.

On the Bhola river between Chandpai and Dhansagar Revenue Stations, a few Chittagonian settlers use *singra* fuel for drying fish during the rainy season.

##### Khulna Subdivision.

Senhati on the Bhairab above Khulna :—*Golpatta* leaves, *goran* and *singra* fuel.

Daulatpur on the Bhairab above Khulna, Khulna town, and Baitaghata on the Rupsa river :—*Singra*, *goran* and *sundri* fuel, and *golpatta* leaves.

Phultala and Barakpore on the Bhairab river above Khulna, and Nehalpur on the Bhairab below Khulna :—*Amur* and *goran* poles for *hookah* stems.

Khulna Match Factory :—*Gengwa* logs.

Kamarghata on the Bhairab above Khulna, and Palerhat on the Bhairab below Khulna :—*Golpatta* leaves.

Chalna and Bajua on the Passar river :—*Baen*, *singra* and other fuel, and an occasional business in *baen* logs and *golpatta* leaves.

Dumuria on the Bhadra river :—*Golpatta* leaves, and *baen* and other fuel.

Baroari *hat* on the Bhadra river :—*Baen*, *singra* and other fuel, *dhundal* and *goran* poles.

Chandkhali, Koyra *hat* and Bedkasi on the Kabadak river :—*Goran* and *dhundal* house-posts, *goran*, *baen* and *singra* firewood, *baen* planks, *golpatta* leaves, honey and wax.

#### *Satkhira Subdivision.*

Baradal on the Kabadak river, and Noabenki on the Kholpetua river :—*Baen* planks, *goran* and *dhundal* poles, *goran* and *singra* firewood, *golpatta* leaves, honey and wax.

Kaliganj on the Jamuna river, Nakipur on the Kadamtala *gang*, and Haldarkhali on the Madar *gang* :—*Goran* poles, *Goran* and *baen* fuel, and *golpatta* leaves.

Debhata on the Jamuna river :—Shells.

Durmujkhali on the Kalindri river :—*Goran* poles and fuel.

Kalaroa on the Betna river :—*Golpatta* leaves, *Goran* and *Baen* fuel.

### 24-Parganas District.

#### *Basirhat Subdivision.*

Baduria, Basirhat, Taki and Itinda on the Ichamatti; and Hingulganj on the Jamuna river :—*Goran* poles, *baen*, *singra* and *goran* fuel, and *golpatta* leaves; Hingulganj is also an important market for honey, wax, and *dhundal* posts.

Kalinagar on the Kalinagar *khal*, a tributary of the Kalagachi river; Hatgacha on the Hatgacha river; and Harua on the Harua *gang*, north of Kulti Lock :—*Goran* poles and fuel, and *golpatta* leaves.

#### *Alipore Subdivision.*

Canning on the Matla river :—Mostly *goran* fuel, some *goran* and *dhundal* poles.

Dhosa on the Piali *nodi* :—*Goran* and *baen* fuel, *goran* poles, *hantal*, *tora*, *garjan*, honey and wax.

Bagmari and Nalkora on the Moni *nodi* :—*Goran* poles and fuel, and *hantal*.

Naldari on the Hooghly :—*Baen* fuel.

#### *Diamond Harbour Subdivision.*

Nijkhari and Mathurapur on the Khari *khal*, a tributary of the Moni *nodi* :—*Goran* poles and fuel, and *hantal*.

Satpukur on the Satpukur *khal*, a tributary of the Mridabhanga *gang* :—*Goran* poles and fuel, and *hantal*.

Jumainaskar *hat* on the Balikhali *khal*, a tributary of the Saptamukhi *via* the Banstala *khal* :—*Goran* and *kirpa* poles, *goran*, *baen* and other fuel, and *hantal*.

Kakdwip on the Muriganga river, and Diamond Harbour and Kulpi on the Hooghly river :—*Goran*, *baen* and other fuel, *garjan* and *goran* poles, and *hantal*.



### Calcutta and environs.

Circular Canal, from Shambazar to Haritola :—*Goran* fuel, poles and bark ; *gengwa* logs, poles, planks, dunnage and rejected poles, waste slabs and pieces for fuel ; *golpatta* leaves ; and *sundri* poles for cart axles.

East terminus of the Beliaghata Main Road, on the New Canal :—Shells.

Bally and the Hooghly river north of Howrah Bridge :—*Golpatta* leaves, *baen* and *goran* fuel.

Metia Bruz on the Hooghly, Kidderpore at the junction between Tolly's Nala and the Hooghly, and Kalighat and Chetla on Tolly's Nala :—*Golpatta*, *gengwa* dunnage, and occasionally *gengwa* logs and poles, *sundri* poles, *goran*, *baen* and other fuel.

Sankrail on the Hooghly, Howrah district :—*Baen* fuel.

Radhapur on the Rupnarayan river, Howrah district ; Ulubaria and Pir Sarenga on the Hooghly river, Howrah district :—*Baen*, *goran* and other fuel, and *hantal*.

### Midnapore District.

Gewakhali at the junction between the Hooghly and the Rupnarayan river, Talpati and Kukruhati on the Hooghly :—*Baen*, *goran* and other fuel, *math goran garjan* and *goria* poles, and *hantal*.

Teropaika on the Haldi river :—*Gengwa* and other fuel, *math goran* poles, and *hantal*.

The *baen* fuel sold in the markets of the Howrah and Midnapore districts, and in the northern part of the Diamond Harbour subdivision on the Hooghly river, is used mostly for baking roof-tiles and pottery. This fuel comes from the Western Sundarbans, and is generally *white baen* ; it is sold in 3 to 4½ foot lengths.

### Lines of Export.

68. **General description.**—Practically, the export to the various markets is exclusively by natural water channels and artificial canals. The only other type of route, used to any extent, is the railway from Canning on the Matla river to Sealdah Station, Calcutta. Formerly, this route was a very busy one for *goran* fuel ; but, since a recent rise in freight and wharfage rates, the export by this line has been rapidly declining. The main north and south routes from the forest are the following river systems :—

- (1) The Madhumati, Baleswar river, and its tributary the Kacha river.
- (2) The Bhairab, Rupsa, Kajibagha, Passar river.
- (3) The Bhadra, Ghengrail, Badurgacha, Sipsah river.
- (4) The Kabadak, Arpangasia river.
- (5) The Ichamati, Jamuna, Kalindri, Raimangal river, with its tributary the Kalagachi gang.
- (6) The Bidyadhari, Matla river.
- (7) The Thakuran river, with its tributary the Moni nodi.
- (8) The Mridabhanga gang, Mural gang, and Curzon Creek.
- (9) The Banstala khal, Ghugudanga gang, and Saptamukhi river.
- (10) The Hooghly and Muriganga rivers.

The courses of these rivers are plainly marked on the modern maps, and a description of them would be superfluous. Within the forests, the *bharani khals* or connecting links between these systems are adequate and numerous ; but for reasons described in Chapter I, the smaller rivers and *khals*, through the *bunded* lands to the north of the forest, are gradually silting up : this applies most notably to the southern part of the Bagerhat subdivision, across which there is no satisfactory route to the Barsakati markets. Consequently, the remaining *bharanis* between

the different river systems become important: very often, they are shown incorrectly on the maps. The following paragraphs give the more important *bharanis* to the north of the forests.

69. **Khals between the Madhumati, Baleswar and the Bhairab, Passar rivers :—** Where the Baleswar passes the forest, it is far too rough to be passable by boats laden with forest produce, except in the calmest weather of the winter season; consequently, for the export to Barisal, Faridpur, and the eastern parts of the Jessore district, the *bharanis* between the Passar and Baleswar are most important. The Atharabanki river, which leaves the Passar at Khulna and joins the Madhumati at Mollahat, makes a suitable route to the Faridpur district; and in the Jessore district, the Bhairab has numerous tributaries, which serve to reach most parts of that district east of the Kabadak river. Further south, *bharanis* for serving the Barsakati markets up the Kacha river are few, small, and shallow; they are silting up more and more each year. Starting from the north, they are as follows:—

- (1) From the Passar river, *via* the Arua Mongla or Mongla river to Rampal, and from thence, *via* the Kumarkhali, Betibunia river, Kalibunia Doani *khal* and Chhoybanki river to the Poylahara river; from thence, north going boats proceed, *via* the Daratana river, Bagerhat, and an artificial channel called the Kachua Cut, to the Baleswar; or for boats proceeding *via* the Kacha river to Barisal, southwards down the Poylahara and Ghasiakhali rivers to Morrelganj, and from thence, *via* the Panguchi river to the Baleswar. This *bharani* is a very round-about route for Barisal boats, and the Kalibunia Doani *khal* is passable by large loaded boats only at high tide.
- (2) From Jewdhara Forest Station on the Bhola river, *via* the Jewdhara *khal* to Morrelganj. This route is passable only by small loaded boats of up to about 400 maunds capacity at high tide during the rains; during the dry season, only small 25 or 50 maund *dinghies* can pass.
- (3) From Dhansagore Forest Station, there is another *bharani*, *via* the Dhan-sagar and Ghooper *khals* to the Baleswar. This route is in a similar state to the preceding one.
- (4) *Via* the Dasher Bharani and Choddarashi *khal*, from the Bhola near Sarankhola police-station, to the Baleswar. This *bharani* will take the largest Barsakati boats at high tide. It is an artificial channel made by the local zamindar, who charges a fairly heavy toll on boats passing through it. This is the most satisfactory route to the east. At some future date, Government will probably find it necessary to acquire this canal, in order to improve its facilities, and to prevent one zamindar from holding the monopoly of the export of forest produce to the Barsakati markets.
- (5) The only other *bharani* is the artificial channel, cut by the Forest Department, on the forest boundary between the Bhola river and Bogi *khal*. This is passable only by small boats of 100 to 150 maunds capacity, during the high spring tides; moreover, where the Bogi *khal* meets the Baleswar, the latter is too wide and too rough to make it an important route.

70. **Khals between the Bhairab, Passar and the Bhadra, Sipsah rivers.**—Connections between these two rivers are numerous and cause no anxiety. The main route for large loaded boats leaves the Passar at Chalna; proceeds *via* Chunkuri *khal* to Dacope; and from thence, either *via* the Dhaki river, or *via* the Bhadra and Sutarkhali *khal*, to the Sipsah. Another important route, further north, used mainly by loaded boats travelling from the Passar to Dumuria and the north-west, is *via* the Jhabhabia river, or the Baitaghata *khal* to the Bhadra river.

71. **Khals between the Bhadra, Sipsah and the Kabadak, Arpangasia rivers.**—The most important route is Cut No. 2 or Kata *khal*, between Paikgacha on the Sipsah to Baradal on the Kabadak river; this canal was cut by the Irrigation Department, and may either be approached by the upper reaches of the Sipsah, or by the Menaj *nodi*. The Kata *khal* is navigable by launch at high tide, and forms a quick route for Divisional Officers, from Khulna to the Western Sundarbans. A

more southern route from the Sipsah, is *via* the Harda *khal* on the forest boundary, past Amadi, and *via* the Koira *gang* to the Kabadak river; this route is much used by *gengwa* boats on their way from the eastern forests to Calcutta.

**72. Khals between the Kabadak, Arpangasia and the Ichamati, Kalindri, Raimangal rivers.**—The main route between these two rivers is a continuation of the Katakhal route, which leaves the Kabadak river at Baradal, and proceeds *via* the Maricha river to Assasuni; from thence, *via* the Assasuni *khal*, Cut No. 1 or the Uzipur Kata *khal*, and the Coxali or Kaksiala *khal* to Kaliganj; and from thence, *via* the old Jamuna river to the Ichamatti river. A north-westerly route used by loaded boats from Burigoalni Forest Station, is *via* the Kholpetua river, Ghalghasia river, Banstala *khal*, and Coxali *khal* to Kaliganj. The route *via* the forest boundary between Kadamtala and Koikhali Forest Stations (namely, *via* the Dumkoli, Singartali, Churkuni, Mathabhanga, and Dhajikhali *khals*), is passable by fairly large boats during high tide. Intermediate north and south routes are the Betna, Kholpetua river which flows past Kalaroa and Satkhira, and the old Jamuna river and Madar *gang* which connect Kaliganj and Syamnagar with the forest.

**73. From the Ichamati, Kalindri, Raimangal to the West.**—From the Kalindri river to Calcutta, the route taken by loaded boats from the eastern forests, is a continuation of the routes across the Khulna district which finish *via* Kaliganj. From the Kalindri river, it proceeds *via* the Barakulia *khal* and the Sahebkhali *khal* to the Raimangal river; from thence, *via* Kalagachi *gang* or the Kalihara *gang*, Hatgacha *khal*, and Chaumuha *gang*, to Kulti Lock; thence, *via* the Eastern Canal (locally called the Bhangar Kata *khal*) to the junction between the Beliaghata and the New Canal. From this place, boats for the Beliaghata markets proceed up the Beliaghata Canal, and boats for Shambazar, Bally, and the Hooghly proceed *via* the New Canal and Chitpur Lock to the Hooghly; boats for south Calcutta, Kidderpore, and markets on Tolly's Nala, also proceed *via* this route, because the connection from Beliaghata to Kidderpore *via* Tolly's Nala, has silted up. The canal route to Calcutta is passable by the forest launches, except during the rains, when the "Harrier" and the "Hawk" cannot pass under the bridges.

From the Raimangal to the Muriganga river there are many alternative routes at or near the boundary of the forests, which are mostly very circuitous. The most direct route, and the one passable by launches is as follows:—From the Raimangal, *via* Kalagachi *gang*, Piprakhali Dhulia *khal*, Bainboali *gang*, and Pathankhali *khal*, to Basanti Forest Station; and thence, *via* the Hooghly *nodi* to the Matla river; from the Matla river to the northern end of the Thakuran, *via* Kultali *gang*, Cooltallah Forest Station and Baksa *gang*; down the Thakuran, and to the Mural *gang*, *via* the Moni *nodi*, Nalkora Forest Station, Raidighi *nodi* and Pukchara *nodi*; or direct from the Thakuran, *via* the Pukchara *nodi*, or *via* Sibua *gang* and Chirpat *nodi*; from Mural *gang* to the Saptamukhi *via* Barchara *nodi*, or *via* Habilla Creek; from the Saptamukhi to the Muriganga, *via* Hatalia Duania *khal*, Namkhana Forest Station and Duar Agra *gang*. The two main routes leading from the Hooghly into the interior of the Midnapore district, are the Haldi and the Rupnarayan rivers.

**74.** Chittagong, Noakhali and the southern part of Bakarganj can be reached across the estuary of the Baleswar and the Bay of Bengal; this route is passable only during the calms of the winter season.

### Methods of Exploitation and their Cost.

**75.** Both timber and minor produce are sold standing, and fuel is either sold standing, or is collected by purchasers from the tops of trees felled for timber. No extraction has ever been undertaken by Government in the Sundarbans, except on a very small scale for experimental purposes or for departmental use. At present, *sundri*, *passur*, *keora* and *kankra* are hammer-marked and auctioned; all other species are sold at royalty rates, and their felling or cutting is unregulated. In this plan, all species which grow to log size will be hammer-marked before felling, and the exploitation of all trees will be confined to coupes and be under supervision.

**76.** All forest produce is brought out of the forests by boats; it is owing to the comparative cheapness of this mode of export, that Sundarbans timber and fuel can undersell larger and better types from other localities. Logs of *keora* and

*baen* are lashed on to *dabbas* laid across the boat, so as to form a raft with the boat in the middle; such rafts move very slowly, and are difficult to handle in the swift currents of the Sundarbans. All other types of produce are loaded inside the boats. In order to convey an idea of the sizes of the boats used, the following table gives the numbers of boats of different sizes, which left the Sundarbans laden with forest produce during the year 1928-29:—

Size of boats by measurement according to the notified rules.	Number of boat-loads.	Maundage of forest produce exported.
Maunds.		
100 and under .. .. .	59,038	2,889,275
125 to 200 .. .. .	12,677	2,071,900
225 to 300 .. .. .	4,381	1,165,400
325 to 400 .. .. .	1,968	711,975
425 to 500 .. .. .	1,912	882,550
525 to 1,000 .. .. .	3,761	2,671,525
1,100 to 2,000 .. .. .	1,109	1,536,300
2,100 to 5,000 .. .. .	487	1,397,100
Over 5,000 .. .. .	6	33,500
Total for the year .. .. .	85,339	13,359,525

Since 1911, the proportion of boats under 500 maunds has not altered very much, but there is a decrease in the use of boats of over 2,000 maunds; boats of over this maundage take a very long while to load, and are, therefore, comparatively expensive for boat hire.

77. Most types of produce are taken out of the forests to the boats by shoulder. In the case of large boats, the produce is first shoulder-borne to small *dinghies*, and then carried by the *dinghies* to the large boats. As there is a close network of small creeks throughout the forests, the lead over which the produce has to be shoulder-borne, seldom exceeds more than two or three hundred yards. Extraction paths are cut for the comparatively long and heavy logs and poles of *sundri*, but are seldom necessary for fuel and other small material, unless the lead goes through thick *goran*, *hantal* or thorn jungle. The logs of *keora* and *baen*, and the larger logs of *sundri*, are extracted by dragging and levering over corduroy paths made of cut saplings: in recent years, some progress has been made in enticing the woodcutters to use the branches of felled trees, instead of cutting young saplings for these paths. In the case of *gengwa*, which is a light wood, the logs are often floated down from the sources of the small creeks to the larger creeks, before being loaded in the *dinghies*.

78. As there is no departmental extraction in the division, our knowledge of extraction and transport costs is very sketchy indeed. Woodcutters and merchants are not willing, as a rule, to disclose their true expenses and profits. However, in the case of small sized produce, the competition amongst the woodcutters is fairly keen, and the average wholesale prices ruling in the different markets, probably represents something very near the actual costs of extraction and transport, together with the royalty rate. In 1928, some *sundri* fuel of various sizes cut from the tops of felled trees, was extracted departmentally, and brought to Khulna in the coolie boats generally used for the marking coupe. The cost of labour for the extraction, transport and unloading at Khulna, was Rs. 21-6 per 100 maunds. After adding

the royalty rate of Rs. 3 and making an allowance for the boat hire, the cost would come to something like Rs. 28 to Rs. 29 per 100 maunds, which is the average wholesale rate at Khulna.

79. In the case of larger sized timber, the work is more strenuous and skilled, and competition is not nearly so keen; consequently, the woodcutters' profits or wages are higher. The *boali sundri* cutters of Barsakati work on the profit-sharing system. The *gomostha*, or headman of a party, takes 2 per cent. of the whole profit; the *mohajon*, or financier, takes one-third of the remainder; and the rest is divided equally amongst the *boalies*, including the *gomostha*. For 150 average sized *sundri* logs, which fill a boat of about 600 maunds capacity, a reliable *gomostha* estimates the cost of extraction and export to Barsakati, as follows:—

	Rs.
(1) Extraction and loading—	
Labour (calculated at 12 annas per day, including food) .. .. .	62
Hire of 2 <i>dinghies</i> .. .. .	5
(2) Transport to Barsakati—	
Hire of boat for 1 month .. .. .	25
Wages of crew for 1 month .. .. .	40
Total .. .. .	132

for 600 maunds, or about 3 annas 6 pies per maund, 4 annas 2 pies per cubic foot, or 14 annas per average sized log. After allowing for this cost and the auction price of the timber, any profit realised on the sale of the boat-load would be divided in the manner already described. Thus if satisfactory profits are made, the *boali* labourer eventually gets nearer Re. 1 per day than the 12 annas quoted in the estimate.

### Past and Current Prices.

80. **Prices in 1892.**—The following is a summary of the prices reported in Mr. Heinig's Working Plan, written in 1892:—

#### SUNDRI.

(i) Logs ..	Calcutta .. .. .	Rs. 4 to Rs. 10 per log.
	Barsakati markets .. .. .	Rs. 2 to Rs. 6 " "
	Other markets .. .. .	Rs. 2 to Rs. 8 " "
(ii) Posts ..	Chalna .. .. .	Annas 8 each.
(iii) Firewood ..	Barsakati markets .. .. .	Rs. 16 to Rs. 30 per 100 maunds.
	Calcutta, Baradal and Basra .. .. .	Rs. 25 to Rs. 30 " " "
	Chalna, Dumuria, Khulna, Basirhat, Baduria and Nurnagar .. .. .	Rs. 20 to Rs. 25 " " "

#### PASSUR.

(i) Logs ..	Khanjia .. .. .	Rs. 3 to Rs. 4 per log.
(ii) Posts ..	Khulna, Dumuria and other local markets .. .. .	Rs. 60 to Rs. 125 " 100 posts.
	Inferior poles from western forests at Basra .. .. .	Rs. 30 to Rs. 40 " " "

## KEORA.

Logs	..	Barsakati markets	..	Rs. 1 to Rs. 3 per log.
		Chalna	..	Rs. 1 to Rs. 2 „ „
		Inferior logs from western forests at Basra	..	As. 8 to Re. 1 „ „

## GENGWA.

(i) Logs	..	Calcutta	..	Rs. 3 to Rs. 4 per log.
(ii) Firewood	..	Calcutta, Basra and Salkia Dhosa and Khari	..	Rs. 20 to Rs. 26 „ 100 maunds. Rs. 8 to Rs. 12 „ „ „

## GORAN.

(i) Posts	..	Calcutta	..	Rs. 20 to Rs. 25 per 100 posts.
		Barsakati markets	..	Rs. 16 to Rs. 25 „ „ „
(ii) Firewood	..	Calcutta	..	Rs. 24 to Rs. 30 „ „ maunds.
		Other markets	..	Rs. 20 to Rs. 28 „ „ „

## AMUR.

Posts	..	Calcutta	..	Rs. 15 to Rs. 20 per 100 posts.
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## KIRPA.

(i) Posts	..	Calcutta	..	Rs. 12 to Rs. 25 per 100 posts.
		Other markets	..	Rs. 6 to Rs. 12 „ „ „
(ii) Firewood	..	Calcutta and Baduria	..	Rs. 20 to Rs. 26 „ „ maunds.

## GOLPATTA.

Leaves	..	Calcutta and 24-Parganas district	..	As. 12 to Re. 1 per 100 leaves.
		Khulna district and Barsakati markets	..	As. 8 to As. 12 per 100 leaves.
NAL	..	..	..	Annas 2/3 per 100 stems.
HANTAL	..	..	..	Rs. 10 to Rs. 15 per 1,000 leaves and annas 10 per 100 stems.
SHELLS	..	..	..	Rs. 20 to Rs. 38 per 100 maunds.
WAX	..	..	..	From Rs. 25 per maund in Barisal and the east, to Rs. 50 per maund in Calcutta on the west.
HONEY	..	..	..	Rs. 5 to Rs. 6 per maund.

81. **Prices in 1911.**—In 1911, Mr. Trafford gave the following prices in his Working Plan, they appear to be mostly wholesale Calcutta rates:—

Sundri logs	..	..	Rs. 5 each average.
Sundri poles	..	..	Rs. 2-8 each average.
Sundri firewood	..	..	Rs. 35 to Rs. 40 per 100 maunds.
Gengwa logs	..	..	Re. 1 each.
Gengwa firewood	..	..	Rs. 30 per 100 maunds.
Goran poles	..	..	Rs. 15 to Rs. 18 per 100 pieces.
Goran firewood	..	..	Rs. 45 per 100 maunds.
Golpatta	..	..	Annas 8 per 100 leaves.
Wax	..	..	Rs. 60 per maund.
Honey	..	..	Rs. 16 per maund.

82. **Current prices.**\*—The following are the current prices in the most important markets, compiled mostly from information received from the officers in charge of the various coupes and revenue stations:—

### SUNDRI.

#### (i) Timber.

CALCUTTA.—Logs, wholesale, Rs. 2 to Rs. 2/8 per cubic foot: the price has risen within recent years, due to the long distances of the *sundri* coupes from Calcutta and the very limited sale. Poles for hubs and axles of cart wheels, average size 7' 0" by 1' 4" girth: wholesale, As. 6 to As. 7 each; retail, As. 8 to As. 9 each: namely, As. 8/4 and As. 10/11 per cubic foot, wholesale and retail respectively.

BARSAKATI.—Logs of 3' 0" girth and over at the thick end, and 18' and over in length: wholesale, As. 7/1 per cubic foot; retail, As. 13/10 per cubic foot. These prices have been calculated, logs are sold by the piece, and not at cubic foot rates; an average log fetches about Rs. 5 wholesale and Rs. 9/8 retail. Logs of 2' to 3' at the thick end, and 18' and over in length: wholesale, As. 6 per cubic foot; retail, As. 12/3 per cubic foot; an average log fetches Rs. 2/12 wholesale, and Rs. 5/9 retail. Poles of 1' 6" to 2' 0" girth at the thick end, and over 10' long: wholesale, As. 5/2 per cubic foot; retail, As. 6/11 per cubic foot; an average pole fetches As. 12/6 wholesale, and Re. 1/0/9 retail.

JESSORE.—Selected pieces, averaging 6' 9" long by 1' 2" girth, for axles and hubs of bullock cart wheels: sold direct by woodcutter to cart-maker at As. 7 each; namely, As. 12 per cubic foot.

#### (ii) Fuel.

CALCUTTA.—Wholesale, Rs. 38 to Rs. 45 per 100 maunds; retail, As. 11 to As. 13 per maund. The price in this market has increased by 50 per cent. since 1892.

KHULNA.—The sale is very limited and spasmodic, as it yields the merchant very little profit. Wholesale, Rs. 28 to Rs. 29/8 per 100 maunds actual weight; retail, Rs. 4 per cart-load of 12½ maunds.

JESSORE DISTRICT.—Wholesale, Rs. 30 per 100 *pukka* maunds.

### GENGWA.

#### (i) Timber.

CALCUTTA.—Logs for match-boxes, match-splints and box planking, average size 4' 5" long by 2' 3" girth: wholesale, direct to match factory or sawmill, Rs. 11/4 to Rs. 20 per score, or As. 9 to Re. 1 per log (average, As. 8/11 per cubic foot). Poles suitable only for box planking, average size 6' long by 1' 6" girth: wholesale to saw-mills, Rs. 47 to Rs. 50 per 100 maunds boat measurement. (On an average, about 150 poles=100 maunds boat measurement; the average price is therefore As. 6/2 per cubic foot). Planks, 4' 6" to 6' by 6" by ¾" average size: wholesale, Rs. 65 to Rs. 75 per 50 cubic feet. Dunnage, about 4,500 pieces go to 100 maunds boat measurement: wholesale, Rs. 8 to Rs. 9 per 1,000 pieces; retail, Rs. 9/8 to Rs. 10/8 per 1,000 pieces.

BARADAL.—Logs bought off small boats, to be loaded in large boats for Calcutta: As. 4 to As. 6 each (average As. 3/7 per cubic foot).

KHULNA.—The Khulna Match Factory pays As. 12 each per log of average size 5' long by 2' 4" inches girth, namely, As. 7/1 per cubic foot.

BARSAKATI.—Timber brought in as *jhools*, *mallums*, etc., is sold at very low prices. In 1924, ½" planks of large dimensions were selling at As. 8 per cubic foot.

\* This paragraph was compiled during the years 1928 and 1929; since then, there have probably been some variations from the prices quoted.

(ii) *Fuel.*

CALCUTTA.—Wholesale, Rs. 30 to Rs. 36 per 100 maunds boat measurement; retail, As. 9 to As. 11 per *pukka* maund. Waste slabs and pieces from match factories and sawmills sell at Rs. 22 to Rs. 25 per 100 *pukka* maunds. No other markets use *gengwa* fuel in any appreciable quantity.

## KEORA.

(i) *Timber.*

BARSAKATI.—Logs, 12'—15' long by 4' 0" to 4' 6" girth: wholesale, Rs. 4 to Rs. 5 each (average, As. 4/9 per cubic foot); retail, Rs. 6 to Rs. 7 each (average, As. 6/10 per cubic foot). Small logs, 12'—15' long by 3' girth: wholesale, Re. 1/4 to Re. 1/10 each (average, As. 3 per cubic foot); retail, Re. 1/8 to Re. 1/14 each (average, As. 3/7 per cubic foot). Planks, 15' by 12" by 1 1/4": wholesale, Re. 1 each (As. 10/3 per cubic foot); retail, Re. 1/4 each (As. 10/9 per cubic foot).

KHULNA.—In 1924, a sawmill bought logs of 4' average girth at As. 8 per cubic foot, but the manager defaulted, and the sawmill failed. At present, there is no business in *keora* timber outside Barsakati, where the prices appear to have doubled since 1892.

(ii) *Fuel.*

No sale.

## BAEN.

(i) *Timber.*

BARSAKATI.—Logs, 10' to 12' long, by 4' 6" to 5' girth: wholesale, Rs. 3/8 to Rs. 7 each, according to quality and size (average, As. 5/5 per cubic foot); retail, Rs. 5 to Rs. 10 each (average, As. 7/9 per cubic foot).

BARADAL, NOABANKI AND VILLAGES AROUND KADAMTALA AND BURIGOALNI FOREST STATIONS.—Logs, 7' to 8' long, by 4' to 5' girth: sold direct from woodcutter to sawyer at Rs. 5 each (As. 8/5 per cubic foot). Planks, 6' 9" to 7' 0" long, by 5" to 12" broad, by 3/4": sold by the piece at prices which work out to about Re. 1/4 per cubic foot wholesale, and Re. 1/12 per cubic foot retail. Scantlings, 12' to 13' 6" by 4" to 5" by 4" to 5": wholesale, about Re. 1 per cubic foot. Scantlings, 6' to 7' by 3" to 4" by 3": wholesale, about As. 9 per cubic foot.

RAMPAL.—Logs of average size 12' x 4' girth: Rs. 3 each, or As. 4 per cubic foot. Sawn planks, 12" x 1": retail, As. 12 per cubic foot.

(ii) *Fuel.*

The export of *baen* fuel, as such, was stopped during the currency of the former plan; but, being a popular fuel, woodcutters pay the pole rate of royalty for its collection and there is still an extensive export.

CHALNA.—Wholesale, Rs. 16 per 100 maunds boat measurement.

BARADAL AND CHANDKHALI.—Wholesale, Rs. 12 per 100 maunds boat measurement, green; Rs. 18 per 100 maunds boat measurement, dry.

BASIRHAT.—Wholesale, Rs. 20 per 100 maunds boat measurement, dry.

GEWAKHALI, ULUBARIA, AND THE HOOGHLY RIVER.—3 to 4 1/2 feet lengths for use in tile and pottery manufacture: wholesale, Rs. 50 to Rs. 60 per 100 maunds of 45 seers each, or, on an average, Rs. 48/14/3 per 100 *pukka* maunds. Green fuel for domestic use: wholesale, Rs. 32 to Rs. 40 per 100, 45 seer maunds, namely an average of Rs. 32 per 100 *pukka* maunds.



## PASSUR.

During the currency of the last plan, the sale of this species has been limited to the few trees marked in the *sundri* timber coupes. These trees have been taken to the Barsakati markets, where they fetch about the same price as, or a little less than, *sundri*.

## DHUNDAL POSTS.

HINGULGANJ.—Log sizes : wholesale, Rs. 15 to Rs. 25 per score ; retail, Re. 1 to Re. 1/8 each. Pole sizes : wholesale, Rs. 5 to Rs. 10 per score ; retail, Rs. 6 to Rs. 12 per score.

BARADAL, BAROARI AND NOABENKI.—Log sizes : wholesale, Rs. 20 to Rs. 30 per score, or about Rs. 20 per 100 maunds boat measurement, retail, Re. 1/4 to Rs. 2 each. Pole sizes : wholesale, Rs. 5 to Rs. 15 per score, or about Rs. 10 per 50 maunds boat measurement ; retail, Rs. 6 to Rs. 20 per score.

BARSAKATI.—Posts, 10' long by 3" diameter : retail, As. 3 to As. 4 each (As. 7 per cubic foot).

## GORAN.

CALCUTTA.—Posts, average size 10½ feet long by 1·8 inches diameter : wholesale, Rs. 18 to Rs. 25 per 100 ; retail, As. 4 to As. 6 each. Fuel : wholesale, Rs. 43 to Rs. 70 per 100 *pukka* maunds ; retail, As. 8 to Re. 1 per maund. Bark : wholesale, As. 3/6 to Re. 1/4 per maund, according to quality and demand.

MIDNAPORE DISTRICT, DIAMOND HARBOUR SUBDIVISION, AND MARKETS ON THE HOOGHLY BELOW CALCUTTA.—*Math goran* posts, 12' long by about 2" average diameter : wholesale, Rs. 35 to Rs. 50 per 100 ; retail, As. 7 to Re. 1 each. *Goran chittas*, 10' long and under 2" in diameter : wholesale, Rs. 20 to Rs. 40 per 1,000 ; retail, Rs. 7 to Rs. 14 per 100. Fuel : wholesale, Rs. 25 to Rs. 50 per 100 *pukka* maunds ; retail, As. 8 to As. 12 per maund.

CANNING.—Fuel : wholesale, Rs. 8 less than Calcutta rate per 100 *pukka* maunds ; retail, As. 8 to As. 12 per maund. Posts 10' by 3" diameter, and *chittas* 9'×1' 6" diameter : retail, As. 12 to As. 14 per maund.

TAKI, HINGULGANJ, BASIRHAT, AND THE MARKETS ON THE ICHAMATI JAMUNA RIVER.—Posts, 10' to 12' long : wholesale, Rs. 3 to Rs. 5 per score ; retail, Rs. 4/8 to Rs. 6 per score. *Chittas*, fairly thick, 10' long : wholesale, Rs. 2 to Rs. 4 per 100 ; retail, Rs. 2/8 to Rs. 4/8 per 100. *Chittas*, thin, 9' long : wholesale, Re. 1 to Rs. 2 per 100 ; retail, Re. 1/4 to Rs. 2/8 per 100. Green fuel : wholesale, Rs. 25 to Rs. 30 per 100 *pukka* maunds ; retail, As. 4/9 to As. 6 per maund. Dry fuel : wholesale, Rs. 40 to Rs. 45 per 100 *pukka* maunds ; retail, As. 8 per maund.

BARADAL, BEDKASI, KOYRA AND NOABENKI.—Posts, average length 10', 10 to 12 scores=100 maunds boat measurement : wholesale, Rs. 2 to Rs. 3 per score ; retail, Rs. 2/8 to Rs. 4 per score. *Chittas*, 8'—10' long, 1,000 to 1,200=100 maunds boat measurement : wholesale, Rs. 2 to Rs. 3/8 per 100 ; retail, As. 8 to As. 14 per score. Fuel : wholesale, Rs. 30 to Rs. 40 per 100 *pukka* maunds.

DUMURIA.—Posts, 10' average length : wholesale, Rs. 2/4 per score. *Chittas*, 8'—10' length : wholesale, Rs. 2/4 per 100.

KHULNA.—Posts : wholesale, Rs. 15 to Rs. 25 per 100. *Chittas* : wholesale, Rs. 5 to Rs. 6 per 100. Fuel : wholesale, Rs. 31 to Rs. 40 per 100 *pukka* maunds ; retail, Rs. 5 to Rs. 6 per cart-load of 12½ maunds.

MORRELGANJ, RAYENDA, TUSHKHALI, AND MATBARIA.—Posts, 11' long : wholesale, Rs. 14 per 100 ; retail, Rs. 3/3 to Rs. 4 per score. *Chittas*, 9' long : wholesale, Rs. 2/8 per 100 ; retail, Rs. 3 per 100.

BARSAKATI.—Posts, 10 to 11 feet long by 2½ inches diameter : wholesale, Rs. 15 to Rs. 20 per 100 ; retail, As. 3 to As. 6 each. *Chittas*, average size 9 to 11 feet

by 1.6 inches diameter : wholesale, Rs. 5 to Rs. 7 per 100 ; retail, As. 1/6 each.  
*Chittas*, 9' long by 1 to 1½ inches diameter : wholesale, Rs. 3 per 100 ; retail, pies 9 each.

CHITTAGONG.—Bark : Rs. 2/4 to Rs. 2/8 per maund.

#### SINGRA FUEL.

BARSAKATI.—Green : wholesale, Rs. 16 to Rs. 20 per 100 maunds boat measurement. Dry : wholesale, As. 8 per maund ; retail, As. 8/6 per maund.

BETWEEN DHANSAGAR AND CHANDPAI FOREST STATIONS.—Direct from woodcutters to fish driers, Rs. 14 to Rs. 22 per 100 maunds boat measurement, green.

BAGERHAT.—Price fluctuates very much owing to irregular supply. Dry : wholesale, As. 6 to As. 12 per maund ; retail, As. 10 to Re. 1 per maund.

KHULNA.—Green : wholesale, Rs. 28 to Rs. 30 per 100 *pukka* maunds ; retail, green, Rs. 4/8 per cart-load of 12½ maunds, dry Rs. 6 per cart-load.

BARADAL AND BASIRHAT.—Wholesale, green, Rs. 12/8 to Rs. 18 per 100 maunds boat measurement, dry Rs. 40 per 100 *pukka* maunds ; retail, dry, As. 7 to As. 8 per maund.

#### AMUR.

JHALOKATI, SRIMANTAKATI AND GATRA IN BARSAKATI.—Small house-posts : wholesale, Rs. 4 to Rs. 5 per score. Shorter lengths for making paddles : wholesale, Rs. 9 per 100. Sticks of small diameter for *hookah* stems : wholesale, Rs. 5 to Rs. 6 per 100 pieces.

BARAKPORE, PHULTALA AND MEHALPUR NEAR KHULNA.—Sticks, 5' to 6' length by 2"—3" diameter : wholesale, Rs. 3 to Rs. 4 per 100 pieces. Manufactured *hookah* stems : As. 10 to As. 11 per bundle. (For *hookah* lengths of 10" to 11", 51 pieces make a bundle.)

#### GOLPATTA.

##### (i) *Split leaves.*

Four split leaves=1 ganda, 20 gandas=1 pon, 16 pons=1 kahan, and 18 pons=1 patti. Approximate equivalents of kahans with boat measurement maundage:—For 5 foot to 6 foot lengths, 1 kahan=18 to 20 maunds ; 7 foot lengths, 1 kahan=25 to 30 maunds ; 8 foot lengths, 1 kahan=40 maunds ; 9 foot lengths, 1 kahan=50 to 55 maunds ; and 10 foot lengths, 1 kahan=60 to 70 maunds.

BARSAKATI.—Lengths 9 feet to 12 feet : wholesale, Rs. 9 to Rs. 14 per kahan ; retail, As. 10 to As. 15 per pon.

MORRELGANJ, MATBARIA AND TUSHKHALI.—Wholesale, Rs. 12 to Rs. 13' per kahan ; retail, As. 14 to Re. 1 per pon.

KHULNA.—Eight foot lengths : wholesale, Rs. 7 to Rs. 9 per kahan.

DUMURIA.—Six foot lengths : wholesale, Rs. 8 per kahan. Eight foot to 9 foot lengths : wholesale, Rs. 10 to Rs. 12 per kahan. Ten foot to 11 foot lengths : wholesale, Rs. 15 to Rs. 16 per kahan.

BARADAL.—Nine foot lengths : wholesale, Rs. 12 per kahan.

BADURIA, BASIRHAT, KALAROA AND KALIGANJ.—Average length 10 feet : wholesale, Rs. 8 to Rs. 12 per patti ; retail, Rs. 12 to Rs. 16 per patti. Average lengths of 7 feet : wholesale, Rs. 3 to Rs. 5 per patti ; retail, Rs. 6 to Rs. 10 per patti.

CALCUTTA.—Five foot to 6 foot lengths : wholesale, Rs. 5 to Rs. 8 per kahan of 18 pons ; retail, As. 6 to As. 9 per pon.

*(ii) Leaflets.*

CHITTAGONG.—Strings of leaflets 27 inches to 36 inches long : Rs. 10 to Rs. 16 per 1,000.

## ULLU GRASS.

Retail, Rs. 6 to Rs. 7 per kahan (1,280 bundles of 3 inches diameter).

## NAL GRASS.

Between 5 and 8 kahans equal 100 maunds boat measurement. Wholesale, Rs. 3 to Rs. 4 per kahan. Manufactured mats, 3 foot square : retail, As. 2 each. Mats, 6 foot square : retail, 3 per rupee. Mats, 4 feet by  $3\frac{3}{4}$  feet : retail, 6 per rupee. Mats,  $3\frac{3}{4}$  feet by  $3\frac{1}{4}$  feet : 8 per rupee retail.

## HOGLA.

Sale mostly in Western Sundarbans.

BASANTĪ.—Mats, 8 feet by 8 feet : retail, As. 6 each.

MIDNAPORE DISTRICT.—Mats, 8 feet by 12 feet to 15 feet : wholesale, Rs.  $\frac{2}{8}$  to Rs. 5 per kahan according to quality ; retail, As. 4 to As. 12 per mat.

SOUTH HOWRAH DISTRICT.—Mats, 8 feet by 12 feet to 15 feet : wholesale, Rs.  $\frac{2}{8}$  to Rs.  $\frac{3}{8}$  per kahan ; retail, As. 4 to As. 12 per mat.

## HANTAL.

Sale mostly in Western Sundarbans.

RAMPURA.—Wholesale, Rs. 3 per 100 stems.

KHARĪ.—Wholesale, Rs. 25 to Rs. 40 per 1,000 ; retail, Rs. 3 to Rs.  $\frac{4}{8}$  per 100.

DIAMOND HARBOUR SUBDIVISION.—Wholesale, Rs. 35 to Rs. 40 per 1,000 stems ; retail, Rs.  $\frac{4}{8}$  to Rs. 5 per 100 stems.

MIDNAPORE DISTRICT.—Wholesale, Rs. 37 to Rs. 45 per 1,000 stems ; retail, Rs.  $\frac{4}{13}$  to Rs. 6 per 100 stems.

SOUTH HOWRAH DISTRICT.—Wholesale, Rs. 37 to Rs. 45 per 1,000 stems ; retail, Rs.  $\frac{6}{8}$  per 100 stems.

## HONEY.

CALCUTTA (COTTON STREET, BURRABAZAR).—Wholesale, Rs. 15 to Rs. 18 per maund ; retail, Rs. 20 to Rs. 21 per maund.

HINGULGANJ.—Wholesale, Rs. 13 per maund ; retail, Rs.  $\frac{17}{8}$  per maund or As. 7 per seer.

BARADAL, BEDKASI AND KOYRAHAT.—Wholesale, Rs. 15 per maund or As. 6 per seer.

## BEES' WAX.

CALCUTTA (COTTON STREET, BURRABAZAR).—Raw wax : wholesale, Rs. 35 to Rs. 40 per maund ; retail, Rs. 45 to Rs. 50 per maund. Refined wax : wholesale, Rs. 65 to Rs. 70 per maund ; retail, Rs. 70 to Rs. 75 per maund.

HINGULGANJ.—Partially refined wax : wholesale, Rs. 48 to Rs. 55 per maund. Refined wax, extra pure : wholesale, Rs. 75 to Rs. 80 per maund.

BARADAL, BEDKASI AND KOYRAHAT.—Refined wax : wholesale, Rs. 60 per maund, or Re.  $\frac{1}{8}$  per seer.

## SHELLS.

(i) *Raw shells.*

JHALOKATI AND PATUAKHALI.—*Jongra* : wholesale, Rs. 30 per 100 maunds boat measurement, wet, to Rs. 40 per 100 maunds boat measurement, dry. *Jhinook* : Rs. 60 per 100 maunds boat measurement, dry.

KHULNA.—Sale very rare ; direct from collector to lime burner at As. 8 per maund.

DEBHATA AND SUTIPUR.—Wet shells : wholesale, Rs. 16 to Rs. 18 per 100 maunds boat measurement ; retail, Rs. 20 to Rs. 25 per 100 maunds boat measurement.

CALCUTTA.—Wholesale, Rs. 50 to Rs. 55 per 100 *pukka* maunds unloaded on land.

(ii) *Manufactured shell lime.*

JHALOKATI.—*Jongra* lime : wholesale, Rs. 2/8 per maund. *Jhinook* lime : wholesale, Rs. 5 per maund.

KHULNA.—Wholesale, Rs. 5/8 per maund : retail, Rs. 6 per maund.

CALCUTTA.—Wholesale, Rs. 300 per 100 *pukka* maunds.

83. **Non-Sundarbans timber.**—As foreign timbers compete with those of the Sundarbans for boat-building and house-posts, the following prices are of interest :—

## TEAK.

CALCUTTA.—Squared timber, prices per 50 cubic feet—good quality : wholesale, Rs. 210 to Rs. 245 ; retail, Rs. 250 to Rs. 300. Inferior quality : wholesale, Rs. 185 to Rs. 190 ; retail, Rs. 220 to Rs. 225.

KHULNA.—Sawn timber, good quality : large lots, Rs. 5/6 to Rs. 8 per cubic foot, according to size and length. Inferior quality : large lots, Rs. 3/14 to Rs. 6/6 per cubic foot, according to size and length.

## SAL.

CALCUTTA.—Large sized logs : wholesale, Rs. 115 to Rs. 135 per 50 cubic feet ; retail, Rs. 125 to Rs. 150 per 50 cubic feet. Short poles, 16' to 18' long by 4" maximum diameter : wholesale, As. 10 to Re. 1 each ; retail, As. 12 to Re. 1/2 each. Short poles, 16' to 18' long by 12" maximum diameter : wholesale, Rs. 7/12 to Rs. 8 each ; retail, Rs. 8 to Rs. 9 each. Long poles, 25' to 30' long by 6" maximum diameter : wholesale, Rs. 2/14 to Rs. 3 each ; retail, Rs. 3 to Rs. 3/4 each. Long poles, 25' to 30' long by 12" maximum diameter : wholesale, Rs. 13 to Rs. 13/8 each ; retail, Rs. 13/8 to Rs. 16 each. Fuel : wholesale, Rs. 58 to Rs. 63, F. O. R., per 100 *pukka* maunds ; retail, As. 12 per maund.

KHULNA.—Poles of 6 inches diameter—poor quality : wholesale, Rs. 2 per cubic foot : retail, Rs. 2/6 per cubic foot. Better quality : wholesale, Rs. 2/4 per cubic foot ; retail, Rs. 2/8 to Rs. 2/9 per cubic foot. Sawn timber : large lots, Rs. 4/2 to Rs. 4/4 per cubic foot ; small lots, Rs. 4/8 to Rs. 4/12 per cubic foot.

DHOSA HAT.—Posts, 18 feet by 6 inches maximum diameter : retail, Rs. 2/4 each. For posts of over 6 inches diameter : As. 12 to Re. 1 extra, for each extra inch of diameter.

## JARUL.

CALCUTTA.—Squared timber per 50 cubic feet : wholesale, Rs. 75 to Rs. 80 ; retail, Rs. 90 to Rs. 100.

KHULNA.—Sawn timber : Rs. 2/4 to Rs. 3/15 per cubic foot, according to size and length.

## IRONWOOD (PYNKADO FROM BURMA).

CALCUTTA.—Squared timber per 50 cubic feet : wholesale, Rs. 175 ; retail, Rs. 190 to Rs. 200.

KHULNA.—Sawn timber : retail, Rs. 4/8 to Rs. 5 per cubic foot, according to size.

84. **Bamboos.**—Bamboos are used for the same purposes as *goran* poles and *chittas*, and *hantal*, and compete with *nal* grass for matting ; for small rafters and mat walls, bamboos are more durable than *hantal* and *nal*.

CALCUTTA.—*Bhalko* (*Bambusa Balcooa*): wholesale, Rs. 28 to Rs. 38 per 100, retail, Rs. 36 to Rs. 50 per 100 delivered on land on the river side. *Muli* (*Melocanna bambusoides*): retail, Rs. 8 to Rs. 14 per 100. *Bajalia* or *nal* (*Pseudostachyum polymorphum*), small sizes for fencing *pan* gardens : wholesale, Rs. 8 to Rs. 10 per 1,000 ; retail, Rs. 10 to Rs. 15 per 1,000.

DIAMOND HARBOUR, KULPI, GEWAKHALL, AND OTHER WESTERN MARKETS.—*Chapa baria* : wholesale, Rs. 40 to Rs. 50 per 100 ; retail As. 10 to As. 12 each. *Baria* : wholesale, Rs. 35 to Rs. 45 per 100 ; retail, As. 8 to As. 10 each. *Jaba* : wholesale, Rs. 25 to Rs. 35 per 100 ; retail, As. 6 to As. 7 each. Thorny bamboo : wholesale, Rs. 22 to Rs. 30 per 100 ; retail, As. 5 to As. 6 each.

BARADAL.—*Bajalia* : wholesale, Rs. 20 to Rs. 25 per 100 ; retail, 2 to 3 per rupee.

KHULNA.—*Bhalko* : wholesale, Rs. 30 to Rs. 35 per 100 ; retail, As. 7 to As. 8 each. *Jaba* : bought direct from the neighbouring villages at 3 or 4 per rupee.

## CHAPTER IV.

## STAFF AND LABOUR SUPPLY.

## The Staff.

85. Owing to inter-divisional transfers, the composition of the permanent staff varies from time to time, and that of the temporary staff varies with the financial stringency or otherwise of the Local Government. The following was the staff of the division as it stood on the 1st May 1929 :—

*Forest establishment.*—One deputy conservator, 2 assistant conservators, 1 extra assistant conservator, 5 forest rangers, 11 deputy rangers, 18 foresters, 18 temporary foresters, 14 special revenue station officers, 4 temporary coupe overseers, and 40 forest guards.

*Office establishment.*—Eight permanent clerks, 4 temporary clerks, 7 office peons and 1 duftry.

*Lascar establishment for launches and flats.*—Deck crews :—Five serangs, 5 suckanies, 6 tindals, 4 kassubs, 20 lascars, 2 cooks, and 6 sweepers. Engine-room crews :—Five engine drivers, 2 tindals, and 12 kassubs and fireman greasers. Of the above, 1 deck tindal and 2 lascars are temporary, the rest are on the permanent establishment.

*Boat establishment.*—One hundred and seven boatmen attached to revenue stations, 110 boatmen attached to protective patrols, 102 boatmen attached to the timber coupes within the forests, and 5 attached to the inspecting ranger in the western Sundarbans. Total 324 boatmen, all of whom are on the temporary establishment.

*Store and Boat repair establishment at Khulna.*—One store overseer, 2 carpenters and 2 caulkers; in addition, there are carpenters employed more or less continuously on contract rates.

86. The forest staff is insufficient, even for the form of management prescribed under the previous plan; according to that plan, the permanent forest staff in 1911 consisted of one deputy conservator, 3 to 4 gazetted assistants, 6 forest rangers, 17 deputy rangers, 15 foresters, 15 revenue station officers, and 40 forest guards. Consequently, during the 18 years between 1911 and 1929, the permanent forest staff has decreased, instead of having increased in the way that one would expect with the gradual expansion of revenue, which has occurred during this period. Even the scale of establishment given in paragraph 85 shows a larger temporary forest establishment than has been the average during recent years, when owing to lack of funds, the sanction for this establishment has been reduced. These reductions have been effected partly at the expense of efficiency, and partly by reappointing some of the temporary foresters dispensed with as special patrol or checking officers, etc. The succeeding statement gives a comparison of the annual cost of the staff detailed in paragraph 85, with the average cost of establishment actually incurred during the three years from 1927-28 to 1929-30. Under A expenditure, the small excess in the average cost for the last three years is due to the appointment of special patrol officers, etc., in place of some of the temporary foresters curtailed. Under B expenditure, the average cost of the temporary establishment shows a shortage of Rs. 3,032 compared with what the cost should be according to the scale given in paragraph 85. The average actual cost of the gazetted officers, and of the permanent establishment cannot be compared with the scale; it varies with the rates of pay of those who happen to be posted to the division, and there have been a considerable number of inter-divisional transfers during the three years.

### Cost of Establishment charged to A (Conservancy and works).

Particulars.	According to the scale of establishment as it stood on the 1st May 1929.		Average annual cost incurred during the years 1927-28 to 1929-30.
	Number.	Yearly cost.	
		Rs.	Rs.
<b>(1) Lascar Establishment.</b>			
<i>Deck crews.</i>			
Serangs on Rs. 60—3—75 per mensem .. .. .	2	1,710*	
Serangs on Rs. 40—3—55 per mensem .. .. .	1	570†	
Serangs on Rs. 35—3—50 per mensem .. .. .	2	1,046‡	
Suckanics on Rs. 26 per mensem .. .. .	5	1,560	
Tindals on Rs. 24 per mensem .. .. .	6	1,728	
Kassubs on Rs. 21 per mensem .. .. .	4	1,008	
Lascars on Rs. 18— <sup>1</sup> / <sub>5</sub> —19— <sup>1</sup> / <sub>10</sub> —20 per mensem .. .. .	20	4,440§	
<i>Engine room crews.</i>			
Drivers on Rs. 60—3—75 per mensem .. .. .	2	1,710*	
Drivers on Rs. 40—3—55 per mensem .. .. .	2	1,140†	
Drivers on Rs. 35—3—50 per mensem .. .. .	1	523‡	
Tindals on Rs. 27 per mensem .. .. .	2	648	
Kassubs, and fireman greasers on Rs. 24 per mensem .. .. .	12	3,456	
<i>Menials.</i>			
Cooks on Rs. 18 per mensem .. .. .	2	432	
Sweepers on Rs. 18 per mensem .. .. .	6	1,296	
Pay of officiating men to replace those on leave .. .. .		1,250	
Total	67	22,517	22,252
<b>(2) Other Establishment.</b>			
Boatmen on Rs. 14 per mensem .. .. .	324	54,432	
Provision allowance of 217 boatmen posted to coupes and patrols at Rs. 2 per mensem. .. .. .	..	5,208	
Coupe overseers on Rs. 30 per mensem .. .. .	4	1,440	
Store overseers on Rs. 30 per mensem .. .. .	1	360	
Carpenters and caulkers .. .. .	4	1,260	
Total	333	62,700	
<i>Less</i> usual savings on this establishment on account of leave without pay, reduction of boat crews in the calm season, etc. .. .. .		6,500	
Net cost of other establishment .. .. .		56,200	(a)56,992
Travelling allowances .. .. .		416	416
Total A Establishment		79,133	79,660

NOTE—Average pay calculated on the assumption that the length of service of each incumbent in each grade is:—\* 12 years, † 6 years, ‡ 7 years and § 10 years.

(a) Includes cost of staff employed on daily labour, owing to temporary shortage of sanctioned staff.

## Cost of B Establishment.

Particulars.	According to the scale of establishment as it stood on the 1st May 1929.		Average annual cost incurred during the years 1927-28 to 1929-30.
	Number.	Yearly cost.	
		Rs.	Rs.
<b>(1) Pay of gazetted officers.</b>			
Deputy conservator .. .. .	1	10,800	
Assistant conservators .. .. .	2	12,400	
Extra assistant conservator .. .. .	1	4,440	
Total ..	4	27,640	31,516
<b>(2) Pay of permanent subordinate establishment.</b>			
Forest rangers on Rs. 125 per mensem .. .. .	2	3,000	
Forest rangers on Rs. 100 per mensem .. .. .	3	3,600	
Deputy rangers on Rs. 55 per mensem .. .. .	7	4,620	
Deputy rangers on Rs. 50 per mensem .. .. .	2	2,400	
Deputy rangers on Rs. 45 per mensem .. .. .	2	1,080	
Foresters on Rs. 40 per mensem .. .. .	5	2,400	
Foresters on Rs. 35 per mensem .. .. .	4	1,680	
Foresters on Rs. 30 per mensem .. .. .	9	3,240	
Forest guards on Rs. 12— $\frac{1}{3}$ —16— $\frac{1}{2}$ —20 per mensem .. .. .	40	7,116*	
Total ..	74	29,136	25,409
<b>(3) Pay of permanent clerical establishment.</b>			
Clerks .. .. .	8	6,988	
Peons and duftry .. .. .	8	1,368	
Total ..	16	8,356	8,163
<b>(4) Pay of temporary establishment.</b>			
Foresters on Rs. 30 per mensem .. .. .	18	6,480	
Revenue station officers on Rs. 40—3—100—5—125 per mensem .. .. .	14	12,141*	
Clerks on Rs. 35 per mensem .. .. .	4	1,680	
Total ..	36	20,301	17,270
<b>(5) Allowances.</b>			
Leave allowance .. .. .	..	2,200†	4,274
Travelling allowance .. .. .	..	8,415	8,415
Local allowance .. .. .	..	8,027	8,027
Total ..	..	18,642	20,716
Total B Establishment ..	..	1,04,075	1,03,074

\* The pay of the actual incumbents for the year 1929-30.

† Leave pay has already been included under pay in this case; Rs. 2,200 is merely an estimate for the pay of officiating men to replace those on leave. To fill up vacancies left by subordinates taking short leave, it has been the custom for some years past to appoint only officiating foresters on the lowest grade of pay.



## Labour Supply.

87. The woodcutters who resort to the Sundarbans forests for the purpose of extracting timber and other forest produce, may be divided into two classes, namely:— Professional woodcutters who work in the forests during all seasons of the year, and agriculturists who are only free for outside work during the months of October, November, early December, February, March and April, or during abnormally dry or wet seasons when agricultural operations are impracticable, or when the rice harvest is delayed. Most of the agriculturists only extract the smaller sized produce, large sized timber, such as *keora*, *baen* and *sundri*, is extracted by the professional labour. By comparing the monthly returns of revenue, it is estimated that the professional woodcutters are responsible for 70 to 75 per cent. of the extraction from the forests.

88. The cost of labour varies very much with the locality and the season. The rates for woodcutters vary from about As. 8 per day during the non-cultivating seasons, to As. 12 per day during the cultivating seasons. Cutters of large sized timber, such as *baen*, earn more; their rates vary from As. 8 to As. 12 per day in the non-cultivating seasons, to As. 12 to Re. 1 per day during the cultivating seasons. It is the custom of the *mohajons*, or employers, to supply food to the woodcutters, and allowances have been made for this in the preceding quotations. Casual labour for work outside the forests, or less strenuous work such as marking within the forests, costs anything from As. 6 to As. 12 per day according to the locality, the season of the year, and the results of the local rice harvest. Often during the monsoon, or after an especially good harvest, labour is unobtainable except at very exorbitant rates. Earthwork is done on contract; the rates demanded vary according to the locality. The construction of *bunds* or dykes costs Rs. 3/8 to Rs. 5 per 1,000 cubic feet; the rates for repair are somewhat smaller, and are often charged by the length of *bund* to be repaired, instead of by the cubic. The raising of sites for compounds and of plinths for huts and houses, costs anything between Rs. 3/8 and Rs. 8 per 1,000 cubic feet, according to the length of lead over which the earth has to be carried.

89. **Skilled labour.**—*Gharamis*, or people who are especially skilled in thatching houses, charge anything between As. 8 and Re. 1 per day, according to the quality of their work, the locality, and the season. Carpenters are scarce and inferior outside the larger towns; the rate generally asked is about Re. 1 per day. In the mufassal, sawyers charge from Rs. 2/8 for 2 inch by 3 inch *sundri* scantlings, to Rs. 5/6 per 100 running feet for larger sizes; for *baen* and *keora*, the rate is Rs. 3 to Rs. 4 for scantlings, and Rs. 4 to Rs. 5 per 100 running feet for planks. The cheapest place for sawing in the mufassal, is in the vicinity of Burigoalni and Kadamtala Forest Revenue Stations, where the sawing of *baen* logs is a local industry. In this locality, the sawing rates charged are flat rates of Rs. 3 per 100 running feet for *keora* and *baen* planks and scantlings, and Rs. 3-5-3 per 100 running feet for *sundri*. In Khulna town, the sawing rate for teak, *sal* and ironwood is Rs. 7 per 100 square feet, and for *sundri* the rate is Rs. 8 per 100 square feet.

## CHAPTER V. PAST HISTORY AND MANAGEMENT.

### General History of the Forest.

90. As already stated in Chapter I, the formation on which the Sundarbans stands, is geologically very recent. Two or three thousand years ago, most of the swamp, now under forest, must have been well under sea-level. Until the 16th century, when the main flow of the Ganges changed from the Bhagirathi and the Bhairab to the Padma, the growth of the part of the delta with which we are concerned must have been very rapid: probably, 2 or 3 square miles per year. Since then, accretion on the coast lines has gradually declined. The maps prepared by Major Ellison in 1874 shows very much the same coast-line as that of 1905-1907, except that erosion has been active on the coast-line of the dead part of the delta between the Raimangal and the Saptamukhi. The accretion during this period has occurred mainly within the larger rivers and estuaries. Since 1905-1907, erosion appears to have continued on the coast-line between the Raimangal and the Saptamukhi rivers; but new land formation in the sea has restarted between the Baleswar and Passar on the east, and around the mouths of the Hooghly and Muriganga on the west: about 2 square miles of new land and *char* has formed at Katka and Tiger Point on the east, and a large sandy bank has formed at the mouth of the Muriganga on the west, which consists of about 24 square miles above low tide level, and  $2\frac{1}{2}$  square miles above high tide level.

91. Here and there within the forests, may be found the remains of buildings, indicating that large areas were cleared of forest and inhabited at a not very remote period: most probably within the last five or six hundred years. The most extensive ruins within the present forests are found near the Sipsah river in Compartment 39, and include the famous Shekertek Temple; there are also many ruins existing in the recently cleared areas, the best preserved being the Jatar Deul, near the *Moni nodi* in the 24-Parganas district: this is a lofty building, which still towers above the surrounding country. After the Ganges changed its course, and the Bhairab began to lose its former great volume of stream, there was a gradual influx of salt-water; it was probably for this reason, that these old cultivated areas were abandoned and allowed to revert back into forest.

92. At the advent of British rule, the forests were about double their present size, and *zamindars* on the northern boundaries were allowed to reclaim as much of the jungle bordering on their lands, as they required. During the latter part of the 18th and the beginning of the 19th centuries, colonization was much impeded by the opposition of these old border *zamindars* to any fresh grants of land to the south of their own, to which they considered they had a prescriptive right. It was not until after various surveys and enquiries, that Government definitely assumed the proprietary right to the forests in the Sundarbans under Regulation III of 1828; rules for leases under this regulation were published in 1830. The confidence created by this regulation, made the purchase of leases in the Sundarbans attractive to capitalists, who were willing to sink capital in clearing and *bunding* the forest lands, providing they were certain of a secure tenure: many leases were bought by Europeans of Calcutta at this time. Subsequently, the conditions under which Sundarbans leases have been granted, have been changed from time to time; but the regular reclamation of the Sundarbans may be said to have started in 1830. In the extreme west, the colonization of Saugar Island was much impeded by the continual recurrence of severe cyclones and tidal waves, which swept over the area during the years of 1833, 1842, 1848, 1864 and 1867. These storms caused great loss of life and cattle; one of the main reasons for their destructiveness, was due to the exposed position of the island and the absence of a sufficiently large protective belt of forest. After the storm of 1867, further serious loss of life was prevented by the construction of large fresh-water tanks with embankments  $16\frac{1}{2}$  feet in height, which provided a refuge for settlers and cattle during subsequent storm waves.

93. The leasing of large areas of fresh land in the Khulna district was stopped in 1875, when the remaining unleased forest areas, in what is now the Bagerhat and Sadar subdivisions of the Khulna district, were declared reserved forests under Act VII of 1865. In 1876, most of the remaining unleased forest in the Satkhira subdivision of Khulna, was declared reserved under this Act, and was placed under the jurisdiction of the Forest Department. In 1879, the forests, so reserved, were declared again as reserved forests under the Forest Act of 1878. During the same year, a further small area of 24 square miles in the Satkhira subdivision was declared protected forest; this area was disforested again, and leased out in 1896. In Lot No. 164, north of Koikhali Revenue Station, a small area of 2,200 acres of the reserve was disforested in 1904; other than this, the boundaries of the reserve in the Khulna district remain the same as they were in 1879.

94. The forests of the 24-Parganas district were declared protected in 1879, but colonization in the poor quality western forests has been allowed to proceed. Since the publication of the original notification, no less than 579 square miles have been disforested and leased out for cultivation. The distribution of these colonized areas is as follows:—

			Square miles.
Diamond Harbour subdivision	..	..	311.3
Alipore subdivision	..	..	52.7
Basirhat subdivision	..	..	215.2
Total	..	..	579.2

It was found that purchasers of lots, in many cases, only reclaimed a small portion of the land leased to them, and confined their activities in the remainder to the realising of a *salami* for the forest produce cut from their land, this *salami* being in addition to the royalty rate on all exports paid by the woodcutters to Government. During recent years, this indiscriminate leasing has been stopped, and gradually, the clearing of the disforested lands is approaching completion. At the present time, fresh disforestations are confined to the Diamond Harbour subdivision, where Government, itself, is laying out the capital to embank the land, and is leasing the land so enclosed direct to small cultivators. At the time of writing, Patibania and the northern part of Mahisani Island are being cleared in this way. The remaining protected forests in the Basirhat subdivision, were declared reserved in 1928; the rest of the forests in the 24-Parganas district still remain protected.

#### Surveys.

95. The first survey of the Sundarbans was made by Messrs. Ritchie, Richards and Martin, during the seasons 1769 to 1773; the results of their work were compiled into a chart of the Sundarbans rivers, on a scale of 5 miles to the inch, by Mr. Rennell; only the largest waterways were recorded on this map. In 1810, Captain Robertson surveyed the main water routes from the Hooghly to the Damini in the Noakhali district. During the years 1811 to 1814, Lieutenant Morrieson surveyed the principal rivers and main *khals* from the Hooghly to the Passar; this survey was checked by his brother, Captain Hugh Morrieson, in 1818. In 1813-14, Lieutenant Blane surveyed the coast-line from the Hooghly to the Thakuran. During the years 1821 to 1823, Lieutenant Prinsep surveyed the boundary between the forests and the cultivation, from a little below Kulpe on the Hooghly to Pranpur on the Jamuna river; this boundary survey was continued as far as the Baleswar river by Lieutenant Hodges in 1829; two years later, the latter published a map on a  $\frac{1}{2}$  inch scale, which included both the results of his own, and Prinsep's survey. In 1841, Captain Lloyd prepared a chart of the sea-face, and in 1850, Captain Smyth resurveyed and demarcated Prinsep's and Hodges' boundary line. Revenue surveys were made in 24-Parganas in 1851-1855, in the old Jessore district (including the present Khulna district) in 1855-1859, and in Bakargunj in 1860-1863. The data from these various surveys were collected together by Mr. James Ellison, who published a complete map of the Sundarbans in 1873, on a scale of  $\frac{1}{4}$  inch to the mile.

96. During the seasons 1905-06, 1906-07 and 1907-08, the forests were surveyed in detail by the Bengal Provincial Survey Department. The cost of this survey amounted

to Rs. 2,15,236, and was met by the Forest Department; sheets on a scale of 1 inch to the mile were compiled from it, and were published, under the direction of Colonel F. B. Longe, in 1909. Enlargements of these maps, on a scale of 2 inches to the mile, are available at the Survey of India Office, Dehra Dun. These maps are still in use; since their publication, a certain amount of accretion and erosion has occurred on the sea-face and in the larger rivers, but the sheets are still accurate enough for all practical purposes. The *chars* in the Muriganga river have been corrected by local survey, from time to time; the latest revised sheets of these areas were published in 1924. No revisions have been made in the forest sheets further east; except that the Forest Department have sketched in the small *khals* of various *sundri* timber coupes in greater detail\*; and during the field-work for this plan, subsequent accretions and erosions on the sea-face and in the larger rivers have been recorded as far as possible: this information has been included in the 2 inches printed stock maps prepared for this plan.

### Past Systems of Management and their Results.

97. **Early management.**—The early management of the Sundarbans forests was confined to the realisation of revenue on the export of forest produce. The first recognition of this as a source of revenue was made by Sultan Shuja in 1658, when revising Todar Mal's original settlement of 1582. Shuja created a new *sarkar* called Muradkhana or Jeradkhana, for pasturage and forest produce, with an assessment of sicca Rs. 8,454. During early British rule, the Government was averse to the policy of leasing out forest *mahals*; but there seems to be no doubt that the local *zamindars* continued to realise some sort of toll from the woodcutters.

98. The forests were inspected by Dr. Brandis in 1863; as a result of his recommendation, rights to collect tolls on forest produce were leased out in 1866. Twenty-four blocks were leased in the 24-Parganas district, and 22 in the former Jessore district; they yielded a total annual revenue of Rs. 8,358. The Port Canning Company bought most of these leases, and in 1867 purchased the rest; they thus acquired a monopoly. The rates at which tolls were levied by them are interesting:—

*Timber of all kinds.*—Rupees 8 per 100 maunds. (About the same standard as the present royalty rates.)

*Firewood.*—Rupees 2 per 100 maunds. (Present rate Rs. 3.)

*Thatching materials.*—Annas 12 per 100 maunds. (Present rates Rs. 3 and Rs. 4.)

*Shells for lime.*—Rupees 4 per 100 maunds. (Present rate Rs. 3.)

During the year 1867-68, the company made a profit of Rs. 42,849 on these *bankar* leases. Alleging that the company's methods were oppressive, Government resumed the leases in 1869: the rates charged by the company certainly appear to have been rather high for that period. Further proposals for the realisation of revenue on the forests were put forward in 1869-70 and in 1872-73, but Government were opposed to the idea, on the grounds that the realisation of tolls on forest produce was harassing to the people. During the seasons 1872-73 and 1873-74, Mr. A. L. Home†, Deputy Conservator, made an examination of the present Khulna forests, and Doctor Schlich and Sir Richard Temple visited the Sundarbans in 1874. The result of their joint investigations, was the conclusion that the *sundri* in the Sundarbans was not by any

\*In this way, the small *khals* have been mapped in Compartments Nos. 3, 4, 6, 7, 11, 12, 13, 16, 17, 18, 21, 22, 23, 24, 25, 29, 31, 39, 40, and parts of Compartments 5 and 30.

†It is interesting to note that Mr. Home, in his report on the forests in 1873-74, states with regard to *sundri*—"when mature, vary in girth from 4·5 to 6·5 feet, a girth of 6 feet and over being rare." (Vide Annual Administration Report of 1873-74.) There is also a general tradition amongst the *boalies* that logs of larger girth than at present were at one time available. This has given rise to the belief that the quality of the *sundri* has deteriorated during the last 50 or 60 years. In my opinion, this girth of 6 feet probably refers to areas further to the north than the present reserve, which were then still under forest. In the northern part of Lot No. 7, Compartment 1 in the present forests, *sundri* trees of 4 feet 6 inches girth are still found; consequently, it is not unreasonable to deduce that, further to the north in these eastern areas, girths of 6 feet would be attained if some of these areas were re-afforested. But Mr. Home's data must not be accepted without a certain amount of reserve: in the same report, he "considers that from 25 to 30 years is the limit required for the production of a full grown tree." As far back as the 16th century, before the Ganges changed its course, the forest growth of the Sundarbans must have been comparable with that of the present forests of the Irrawaddy Delta, where *sundri* trees of 120 feet height and 12 feet girth are found in the better quality areas; but during the last century, it is very improbable that the average mature girth of the better quality *sundri* in the eastern part of the present Sundarbans Reserve has deteriorated from about 5 feet 6 inches to 3 feet; though it is probable that a certain amount of depreciation has occurred, especially in poorer forests from the Sipsah westwards, where the headwaters of the main streams have been silting up.

means inexhaustible. Further recommendations were made to Government, more with the idea of preserving the *sundri* than of realising revenue. As a result, the present forests in the Khulna district were reserved in 1875 and 1876, and the remaining forests in the 24-Parganas district were declared protected in 1879.

99. Doctor Schlich considered that the first measures demanded were purely fiscal, and on his recommendation, the first 22 revenue collecting stations were established on the main routes of export. The first royalty rates charged were 1 anna per maund for *sundri* timber, and 3 pies per maund for other types of produce; these rates have been enhanced from time to time: tables giving the royalty rates at different periods may be found in Appendix XIII. During the first year of management by the Forest Department in 1875-76, the revenue realised was Rs. 32,722; this quickly rose, and in 1889-90, the year's revenue amounted to Rs. 4,85,458. Nothing was done for the preservation of the *sundri*, except to fix a girth limit of 3 feet 9 inches at breast height, for the Bagerhat and Khulna blocks; unfortunately, this rule was more honoured in the breach than in the observance; also, as the most vigorous *sundri* is inclined to develop large buttresses, any simple prescription of girth limit, without detailed control, was bound to fail.

100. **Mr. Heinig's plan.**—The former working plans of the division deal mainly with *sundri*, and to a certain extent with *keora*, *passur*, *kankra* and *amur*; the felling of all other species has remained practically unregulated up to the time of writing this report. The first Working Plan, that of Mr. R. L. Heinig, came into force in the year 1893-94. It made the Khulna and Bagerhat forests into two felling series, which were divided into ten annual coupes each. The felling of *sundri* was limited to these coupes, and a minimum felling girth of 3 feet was prescribed. In the Satkhira and 24-Parganas forests, the felling remained unregulated as before. The results of the working of this plan are described in an inspection note, dated the 12th December 1903, by Mr. S. Eardley Wilmot, officiating Inspector-General of Forests. Briefly, this and other past records give the impression that the prescriptions of Mr. Heinig's Plan, both as regards area and girth limit, were adhered to only on paper, the *sundri* forest was in a much more depleted condition than in 1893, when the plan was first brought into operation, *sundri* theft on a large scale was common, and that the proper silvicultural treatment of *sundri* had been sacrificed in order to maintain a high level of revenue: during the currency of this plan, the revenue increased from Rs. 4,68,152 in 1893-94 to Rs. 6,18,142 in 1902-03.

101. **Mr. Lloyd's working scheme.**—A revised working scheme was prepared by Mr. W. F. Lloyd, for the period 1903-04 to 1907-08. The same two felling series were kept, but the annual coupes were cut down to a quarter of their former size, thus increasing the felling cycle to 40 years. Simple silvicultural rules were prescribed for felling the *sundri*, which necessitated hammer-marking all trees below 3 feet girth at breast height, before felling. Although not prescribed in the plan, from the control forms it is evident that the felling of *sundri* was totally stopped in the western forests of Satkhira and 24-Parganas in 1903-04, and in the succeeding year, the felling of *keora* and *passur* was stopped in these forests, and their felling confined to the *sundri* coupes of the Bagerhat and Khulna felling series. In all probability, the felling of *amur* and *kankra* was confined to the *sundri* coupes, in a similar way, about this time. During the currency of this working scheme, the staff was increased, proper provision was made for the supervision of coupes, and boundary patrols introduced. The wholesale *sundri* theft, which was rife during the currency of the former plan, was finally suppressed; the wasteful methods of unregulated felling of this species was stopped; the fellings were made more strictly according to silvicultural rules; a start was made in the system of selling the *sundri* coupes on the monopoly system; and, most important of all, the services of most of the dishonest subordinates, who had been encouraged by the lax regime of former years, were dispensed with. These reformations were due entirely to the strong and energetic rule of Sir Henry Farrington, who was in charge of the division from 1904 to 1908. It was on his recommendation that Government issued the notification in 1906, which tightened up the water transit rules, by prohibiting the transport of *sundri* timber without both hammer-marks and permit. As was only to be expected, the revenue on *sundri* fell to just over a quarter of its former figure under Mr. Heinig's Plan; in succeeding years it slowly recovered, but the annual *sundri* export has never since reached the same volume as that of before 1903-04.

102. **Sir H. Farrington's working scheme.**—The last two years of Mr. Lloyd's scheme were allowed to lapse, and Sir Henry Farrington prepared a fresh working scheme for the period 1906-07 to 1909-10. The felling series and the felling cycle for *sundri* were the same as in the former plan; the main differences were that the mature girth was raised to 3 feet 6 inches, all trees, including the mature ones, were to be hammer-marked before felling, and provision was made for the thinning of overcrowded younger crops, according to the demand and the availability of staff for its supervision. No working scheme or plan appears to have been sanctioned for the two years after the expiry of this working scheme, namely, 1910-11 and 1911-12, but it is evident from the control forms that the same system of management was continued.

103. **Mr. Trafford's working plan.**—For the period 1912-13 to 1931-32, a regular working plan was prepared by Mr. F. Trafford. This plan divided the whole of the forests into two Working Circles, namely, the *Sundri* or Eastern Working Circle, and the Western Working Circle.

*The Eastern Working Circle* (namely, Compartments Nos. 1—40 inclusive) contained all the areas in the Bagerhat and Khulna Forests in which *sundri* was the predominant tree. The exploitable girth for sound *sundri* was kept at 3 feet 6 inches. Only one felling series was prescribed, and the felling cycle was kept at 40 years. In the fresh-water type of forest, where the growth is more rapid, an intermediate type of felling, called a main thinning, was provided for, in order to relieve the congestion amongst the middle-aged poles. With a high exploitable girth of 3 feet 6 inches, the net result of these prescriptions was to make improvement fellings and thinnings on a felling cycle of 20 years in the fresh-water forests, and of 40 years in the more saline areas. Provision was also made for subsidiary, fuel thinnings amongst congested young *sundri* poles and saplings of under 1 foot 6 inches girth, according to the demand and in places where the Divisional Officers thought fit. An exploitable girth of 4 feet was prescribed for *keora*, and one of 2 feet for *amur*, *kankra* and *passur*; and the felling of these species was confined to the *sundri* coupes. The prescriptions regarding the exploitable girths for these four species have not always been followed, because they were unsuitable: particularly with regard to *amur*, for which there is a large demand for small sizes and which very rarely reaches a girth of 2 feet. No restrictions were imposed on the felling of species other than the five already dealt with. The fellings of these other species were continued without any regulation or restriction until 1925, when it became apparent that this type of material was being much over-cut. From 1925, therefore, all fellings of *gengwa*, except for *jhools*, *mallums*, etc., were confined to the forests east of the *Sela gang*, and the extraction of other miscellaneous types of timber and fuel by purchasers with boats of over 200 maunds capacity was also limited to this area. In this way, it was hoped to save the greater portion of the Eastern Working Circle from any more over-felling before the introduction of a new working plan.

*The Western Working Circle* corresponded to Compartments Nos. 41—75 inclusive. The only prescription made for the felling of *sundri*, *passur*, *kankra*, *amur* and *keora* in this working circle, was that their fellings should be confined to trees of exploitable size [see paragraph 40 (b) of Mr. Trafford's Plan]. Presumably, the exploitable sizes intended were those prescribed for the Eastern Circle, namely, minimum girths of 3 feet 6 inches for *sundri*, 4 feet for *keora* and 2 feet for the other three species. No coupes were detailed, no instructions were given as to how the girth limits were to be enforced, and no staff for the supervision of the fellings was available. The net result of this prescription, therefore, was that no fellings were made. Thus, the total prohibition of the felling of these five species in the western forests, brought into force in 1903-04 and 1904-05, has continued up to the time of writing this report (see paragraph 101 of this chapter). For the exploitation of the fuel of species other than the five mentioned, the working circle was divided into five blocks, each in turn to be open to the extraction of firewood by purchasers with boats of over 500 maunds capacity, for a period of six consecutive years. Fortunately, in carrying out this proposal, the control was extended to the felling for timber of these species, as well as for firewood. From 1912-13 to 1929-30, all the forests east of the Raimangal river were worked over by large boats according to this scheme. Purchasers of this miscellaneous timber and fuel with boats of less than 500 maunds capacity, continued to roam over the whole working circle, and were allowed to cut their produce how and where they chose. From 1925 onwards, for the purpose of making the scheme

more effective, and in order to check the over-cutting of these other species, all fellings of *gengwa* (except for *jhools*, *mallums*, etc.) outside the open area were stopped; at the same time, the fellings of other miscellaneous species in the closed areas were limited to purchasers with boats not exceeding 200 maunds in capacity.

*Golpatta*.—The western forests were divided into two blocks for the cutting of *golpatta*, which were closed and opened to exploitation by purchasers with large boats, in alternating periods of one year each. The results have been disappointing; the only effect has been that more plants have succumbed from over-cutting in an area during the open years than in the close years: a period of one year's comparative rest does not appear to strengthen the plants sufficiently, to bear continual over-cutting for the succeeding year.

104. **The effects of past management on the present condition of the crop.**—*Sundri* and *Passur*.—The wholesale over-cutting and wasteful unregulated felling of the *sundri* and *passur* was stopped in 1903-04, 27 years ago. As one would expect, this period has not been sufficient for the age gradations in these species to become normal. In the forests of over 50 feet height growth, *sundri* trees of over 10 inches diameter, or over 110 years of age, are still in deficit; and in the forests of 35 to 50 feet height growth, trees of over 8 inches diameter, or of over 105 years of age, are still short; but there is a thick crop of middle-aged *sundri* below these diameters, most of which needs thinning. The mature trees of *passur* are also in deficit, but to a less extent. During the currency of the last plan, the *sundri* sales did not increase to the proportions needed. This was partly due to the poor quality of timber available for sale from the improvement markings, but the main reasons were due to the system of management. Since 1903, the unregulated felling of the *pukka sundri* and *passur* poles was stopped in the Satkhira forests, and no controlled felling on a coupe was substituted in its place; furthermore, Mr. Trafford, in his plan, combined into one the former two felling series of *sundri* and *passur* in the Bagerhat and Khulna forests, and in most years, the one remaining coupe was situated in the Bagerhat block; this enabled the Barisal *boalties* to obtain a monopoly of the *sundri* sales; gradually, the other markets were lost, and the fellings finished 10 years in arrear. Another reason was that, in order to stop the wholesale *sundri* and *passur* thefts which occurred during the currency of Mr. Heinig's plan, it was necessary to prohibit the sale of these species to local people, and to impose heavy penalties on householders found in possession of unmarked timber. The resulting under-felling has left an excess proportion of middle-aged *sundri* poles in the unfelled compartments. The exploitable girth of 3 feet 6 inches was too high for most areas; many mature trees of smaller girth, which should have been felled and would have fetched large prices, have become unsound. *Passur* is not a gregarious tree, and its regeneration is not so prolific as that of *sundri*; also, when it was open to unregulated felling, small poles for house-posts were, probably, more popular than those of *sundri*. Consequently the excess in middle-aged *passur* poles is not nearly so marked. This under-felling, although responsible for loss of revenue in the past, has had its advantages. The annual volume possibility for the next 20 years will be correspondingly larger, and the present excess of middle-aged growth will help to compensate for the shortage of other species, which have been overcut to a deplorable extent.

105. *Other species*.—During the currency of the last plan, the annual revenue increased from Rs. 5,50,950 in 1912-13 to Rs. 10,33,737 in 1925-26; since this year, the revenue has been declining, and for the last two years, it has been under nine lakhs. During the period 1912 to 1926, the increase has been due solely to the increase in the export of the timber and fuel of miscellaneous species, and of the leaves of *golpatta*. Hitherto, passes for the cutting of these species have been issued at the revenue stations surrounding the forests; on prepayment of the royalty, purchasers have been allowed to enter the forest to cut their produce, load their boats, and return. The actual fellings have been unsupervised and unregulated; naturally, the maximum amount of damage and depletion has been the result. The restrictions with regard to the felling areas of large boats have merely had the effect of concentrating the over-felling in different portions of the forests at different periods. The species which have particularly suffered from this unrestricted and unregulated felling are *gengwa*, *baen*, *dhundal*, *goran* and *golpatta*. Everywhere within the forests may be seen the results of this wasteful method of management. Large *baen* trees have been felled merely for the utilisation of the best log, and the rest left to rot in the forest; in other cases, a branch has been cut off for fuel, permitting the entrance of rot which, in a few years,

has destroyed the timber of the whole tree ; most of the *dhundal* trees left are unsound ; blanks are left in the *goran* jungle, because the woodcutters clear-fell the root clusters, instead of leaving the young withes to keep the roots alive, and to develop into fresh sticks ; *golpatta* is not nearly so plentiful as in former years owing to the fact that numerous rhizomes have succumbed to continual cutting, without a sufficient and regular period of rest. Naturally, this faulty system of management has begun to have an effect on the revenue. During the last three years, the revenue on species other than *sundri* has begun to decline ; this combined with a dull market for *sundri* timber, has brought the revenue down to its present level. There is no doubt that if this system were continued, there would be further and much more serious drops in the revenue in the future. The following statement giving the sources of revenue during the last five years illustrates this fact :—

Year.	<i>Sundri</i> (including <i>passur</i> ).	Other forest produce.	Miscellaneous revenue.	Total.
	Rs.	Rs.	Rs.	Rs.
1925-26 .. .. .	2,74,761	7,27,370	31,606	10,33,737
1926-27 .. .. .	2,23,346	7,68,815	37,820	10,29,981
1927-28 .. .. .	1,37,721	7,61,502	45,552	9,44,775
1928-29 .. .. .	1,40,258	6,93,439	45,506	8,79,203
1929-30 .. .. .	1,86,000	6,65,219	47,347	8,98,566

The revenue on other forest produce reached its peak in 1926-27, and since then has decreased by about a lakh.

106. It would be redundant in this plan, to point out all the evils of unregulated felling ; but, for the benefit of non-foresters it may be explained that, besides a very low percentage of utilisation of the trees actually cut, felling damage to the surrounding crop has been deplorable. As regards the *gengwa*, during the last two years, an attempt has been made to save the remaining crop with the funds at present at the disposal of the division. The felling in the Eastern Circle has been restricted to a coupe, where the utilisation of a reasonable proportion of each tree felled is insisted on, and the felling of trees of under 2 feet girth forbidden. But the felling in the Western Circle is still unregulated, though restricted in volume ; there is also no doubt that more revenue would have been realised, and the utilisation in the coupes of the Eastern Circle would have been much more complete, if there had been sufficient staff to hammer-mark the trees, and to sell them at auction rates. In short, the result of the continual unregulated felling of the miscellaneous species has been disastrous. These species are responsible for about four-fifths of the revenue of the division, and the present condition of their crop is far worse than that of *sundri* was in 1903.

107. **Need for decentralisation into forest ranges.**—Up to the present, the division has never been divided into ranges, and the following charges have been under the direct supervision of the Divisional Officer :—4 or 5 coupes, 23 revenue stations, 2 checking stations, one boat repair and store depot at Khulna, and 24 patrol officers. This makes a total of 54 or 55 people scattered over an area of about 4,000 square miles, whom the Divisional Officer has to attempt to supervise without the help of intermediate subordinates. The defects of this system are obvious ; most of the Divisional Forest Officer's time is occupied with petty matters, both in the field and at his office, which, in an ordinary division, would be disposed of by his Range Officers. No further expansion of coupes, and no real progress in management or silviculture is possible in the division, without decentralisation into forest ranges.

108. **Control of game.**—The close seasons and other hunting rules at present in force are the same as those for the rest of Bengal. Both the reserved and protected forests of the Sundarbans are included in the Class II forests, referred to in notification No. 839 For., dated the 23rd January 1915, and its subsequent amendments. The present close season for deer, namely, the 1st May to the 30th September, is not suitable for the cheetal in the Sundarbans ; the stags are mostly in velvet from the middle of October to the end of March, and the rutting season is from about the middle of April to the end of June.

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One of the main reasons for the increase in the numbers of deer and pig, referred to in paragraph 51 of Chapter II, has been the fact that a very large proportion of the number of tiger in the Sundarbans have been killed off. The partial extermination of the tiger has upset the balance of nature, and has allowed an inordinate increase in the numbers of his natural prey, namely, the deer and pig. That this campaign against tiger has been highly necessary, is evident from the following figures:—

Year.	Number of tigers killed or captured in the forests.	Number of men killed by tiger in the forests.	Year.	Number of tigers killed or captured in the forests.	Number of men killed by tiger in the forests.
1912-13	37	70	1921-22	43	21
1913-14	31	81	1922-23	33	25
1914-15	40	79	1923-24	47	4
1915-16	35	60	1924-25	46	7
1916-17	48	19	1925-26	46	7
1917-18	52	14	1926-27	14	..
1918-19	35	5	1927-28	18	1
1919-20	32	12	1928-29	3	..
1920-21	38	18	1929-30	6	4

The Sundarbans tigers are notorious for man-eating, and, until a few years ago, fully deserved this notoriety. In the dense jungle, he is extremely difficult to hunt; when cases of man-eating occurred on the *sundri* coupes in the past, it was often impossible to shift or kill the offender, with the result that the coupe had to close down. As a consequence, the reward paid by Government for killing a full-grown tiger was as high as Rs. 200; numerous professional shikaries were granted special permits to proceed into the forests to kill these animals, and earned their livelihood by securing the rewards. By this means, the number of men killed by tiger has gradually been reduced: so effectively, that during the three years from 1926-27 to 1928-29, there was only one solitary instance. For this reason, in 1927-28, the number of professional tiger shooting permits was substantially reduced; and, since 1928-29 up to the date of writing, the issue of these permits has been stopped altogether. In letter No. 318-T.—R., dated the 27th May 1927, the Local Government has empowered the Divisional Forest Officer to lower the reward of Rs. 200 for killing tiger to such amounts as he thinks fit; but in case tigers again begin to become a serious menace to life, the Divisional Forest Officer can revert back to the maximum figure at any time. The stoppage of the issue of professional permits, has already had its effect; at the time of writing, tiger and traces of tiger are seen more frequently than they were two years ago. Unfortunately, this increase has been accompanied by a small increase in the number of men killed; in 1929-30, the number of fatalities again rose to four. If this is not merely due to chance, and the number of accidents continues to increase in succeeding years, it will be necessary to raise the reward again to Rs. 200, and to re-employ professional shikaries. At the present time, woodcutters incur a greater danger from crocodile (*Crocodylus porosus*) than from tiger. During the last eight years, these reptiles have been responsible for 60 deaths within the forests. There is no record of the number of fatalities due to crocodile amongst fishermen working within the forests. Except for his occasional man, cattle and carcase eating tendencies, the main food of the crocodile appears to be fish. It has been alleged that the *gharial* (*Gavialis gangeticus*) has been seen in the forest area; if this is really the case, they must be very rare: none have been seen by the writer. Leopards occur on the older and drier formations in the surrounding districts; there are none in the tidal swamps.

#### Miscellaneous Works and Improvements.

109. **Floating craft.**—There are no touring bungalows, and no roads in the division. When on tour, or working within the swamp forests, the more senior officers live either in steam launches or in houseboats (locally called flats), and the

subordinates live in small country-made boat fitted with cabins, etc. The following is a list of the craft attached to the division :—

*Launches with cabin accommodation.*

- S. L. HARRIER, length 105 feet 6 inches, beam 16 feet 8 inches, draft 4 feet 7 inches, twin screw, nominal horse-power 27, built in 1908.  
 S.L. HAWK, length 105 feet 6 inches, beam 16 feet, draft 4 feet 1 inch, twin screw, nominal horse-power 26·4, built in 1902.

*Steam Cutters.*

- S.C. HELEN GREY, length 55 feet 6 inches, beam 10 feet 6 inches, draft 4 feet 8 inches, single screw, nominal horse-power 11·0, built in 1899.  
 S.C. DOROTHY, length 43 feet 6 inches, beam 10 feet, draft 3 feet 6 inches, single screw, nominal horse-power 9·05, built in 1906.

Both the above two cutters have a small cabin, but the S. C. "Dorothy" has no cooking or bathroom accommodation.

*Motor Launch.*

- M. L. SYLVIA, length 30 feet 2 inches, beam 6 feet 4 inches, draft 2 feet 6 inches, Sterling 4 cylinder marine engine, no cabin, built in 1919.

*Flats or Houseboats.*

- Flat SWAN, formerly a twin screw launch, but the engines have been taken out, length 103 feet 9 inches, beam 16 feet 10 inches, draft 4 feet, built in 1892.  
 Flat MARION and Flat VERNON, both of the same dimensions, length 60 feet, beam 13 feet 6 inches, draft 1 foot 8 inches, built in 1897.  
 Flat DRAKE, with pontoon shaped hull, length 52 feet, beam 15 feet, draft 1 foot 10 inches, built in 1881.  
 Flat PELICAN, with pontoon shaped hull and double deck, length 45 feet, beam 17 feet, draft 4 feet, built in 1915, acquired from the Police Department in 1926.

*Wooden craft.*

- Fifty-five small cabin boats for housing the subordinate staff; their sizes vary from 35 feet to 46 feet 6 inches in length by 6 feet to 10 feet beam. They are built on country pattern, and are propelled by oars.  
 One sailing cutter "Merlin" with cabin, length 37 feet 3 inches, beam 7 feet 3 inches, depth from gunwale to keel 3 feet 6 inches.  
 Seven country built boats for housing coolies, of sizes varying from 34 feet 4 inches to 57 feet in length by 8 foot 5 inch to 9 foot 1 inch beam.  
 Seven water-carrying boats, country pattern, sizes from 38 feet to 44 feet in length by 7 foot 1 inch to 9 foot 5 inch beam.  
 One timber carrying boat "Sela," Barsakati pattern, length 44 feet, beam 15 feet 6 inches, depth below gura 5 feet 3 inches.  
 Six clinker built jolly boats, and 130 country pattern dinghies.

110. The maintenance of a large fleet is essential for the proper management of the division. For the prescriptions made in the former plan, the number of flats and small wooden craft was sufficient, but the services of the four gazetted officers could have been made fuller use of, with the addition of another small cabin launch: in

former years, there were three steam launches and three steam cutters attached to the division. The upkeep of this fleet is the largest item of expenditure in the division; the following figures give its average annual cost during the six years from 1924-25 1929-30 :—

	Rs.
Repairs of launches and flats .. ..	41,081
Repairs and reconstruction of boats and dinghies ..	10,048
Marine stores .. ..	9,483
Steam coal and petrol .. ..	10,616
Lascar crews .. ..	21,988
Boat crews .. ..	46,895
Carpenters, store overseer, and travelling allowance of crews .. ..	1,459
Total .. ..	1,41,570

111. **Buildings.**—The buildings at headquarters are brick built, and consist of the Divisional Office, quarters for the Divisional Officer, a rest house for assistant gazetted officers, and quarters for 6 of the clerks. At the boat repair depot at Khulna, there are brick built buildings for the office, quarters for the officer in charge, and a store godown; in addition, there are 4 boat repair sheds with corrugated iron roofs, and other small sheds for the accommodation of boatmen, etc. At each revenue station, there is an office and quarters for the officer in charge. In most stations, the office and quarters are combined in one building; they are wooden constructions, built on piles of from 4 feet to 6 feet in height; most of them have thatched roofs, which are made of *golpatta* in the east of the division, and of *ullu* grass in the west.

112. **Canals.**—Shortly before the introduction of the last plan, a small canal about 1,000 feet long, was constructed between the Kalindri river and Madar *gang*. By natural scouring, this channel has developed into a wide and deep *khal*, through which launches and river steamers may pass at any state of the tide. A similar attempt was made to join up the loop of the Sela *gang* in Compartment 14, but this channel did not scour, and it has now silted up. The small ditch of about 1½ miles in length, dug on the forest boundary between the Bhola river and the Bogi *khal*, has not scoured out as much as was expected. Silting occurs in the middle, where the tides of the Bhola and Baleswar meet; the *bharani* is still passable by dinghy at high tide, and by small boats during the high spring tides. Last year, the portion between the loop in the Bogi *khal* was joined by a ditch, this will shorten the length of the *bharani* considerably, and may induce it to start scouring.

113. **Cultural operations.**—Natural regeneration is, as a rule, very satisfactory in the Sundarbans, and, up to the present, no plantation work has been necessary. Improvements to the crop depend on judicious thinnings; so far, such operations have been confined to the *sundri*, and they have already been described.

## Past Yield.

114. **Yields from various parts of the forest.**—The following statements, compiled from the control forms, give the past annual yields of forest produce from the various parts of the forest, since 1910-11:—

**THE OLD EASTERN WORKING CIRCLE.**  
(Compartments Nos. 1-40 inclusive.)

Year.	1910-11.	1911-12.	1912-13.	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.	1919-20.
<b>Type of produce.</b>	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
(i) Timber—										
<i>Sundri</i> (including <i>passur</i> ) ..	1,014,020	1,431,738	5,26,559	1,044,654	492,940	907,389	798,541	821,128	464,259	960,063
<i>Amur</i> ..	(a)	(a)	(a)	(a)	(a)	(b) 10	32,079	50,838	62,590	102,502
<i>Keora</i> ..	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(b) 5,656	(b) 322	(b) 7,821
<i>Baen</i> ..	(a)	(a)	(a)	(a)	246,947	434,123	434,238	447,272	451,885	610,601
<i>Dhundal</i> ..	(a)	(a)	(a)	(a)	11,900	10,405	9,625	12,337	..	17,805
<i>Gengwa</i> ..	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	1,179,144	1,110,792
Other kinds ..	1,103,640*	1,019,145*	1,716,595*	1,027,964	849,903	256,730	308,914	1,665,548	29,043	30,165
Total ..	2,117,660*	2,450,883*	2,243,154*	2,072,618	1,601,690	1,608,657	1,583,397	3,002,779	2,187,243	2,839,749
(ii) <i>Goran</i> ..	(a)	(a)	(a)	1,409,340	1,079,753	1,075,444	1,438,150	1,617,570	919,959	738,490
(iii) Fuel—										
<i>Sundri</i> ..	1,927,012	1,414,603	2,659,431	2,363,055	1,126,129	631,491	634,459	1,313,600	751,757	405,475
Other kinds ..	3,903,277*	3,310,897*	4,213,168*	3,914,520	4,166,027	4,143,557	4,875,048	2,727,225	3,016,993	2,515,200
Total ..	5,830,289*	4,725,500*	6,872,599*	6,277,575	5,292,156	4,775,048	5,509,507	4,040,825	3,768,750	2,920,675
(iv) Minor Produce—										
<i>Golpatta</i> ..	Mds. 2,556,850	Mds. 2,657,800	Mds. 3,452,350	Mds. 4,653,025	Mds. 3,132,080	Mds. 3,447,700	Mds. 3,441,350	Mds. 3,515,420	Mds. 3,140,275	Mds. 4,140,075
Honey ..	1,403	1,214	1,017	673	1,741	1,367	2,257	2,194	1,200	1,056
Wax ..	177	140	103	74	209	154	259	257	149	126
Other kinds ..	99,475	83,703	73,625	143,925	68,600	90,450	138,575	128,275	90,600	100,975
Total ..	2,657,905	2,742,857	3,527,095	4,797,697	3,202,630	3,539,671	3,582,441	3,646,146	3,232,224	4,242,232

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*Past yield of the old Eastern Working Circle (Compartments Nos. 1—40 inclusive)—concl'd.*

Year.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.	1928-29.	1929-30.
<b>Type of produce.</b>	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
(i) Timber—										
<i>Sundri</i> (including <i>passur</i> ) ..	423,616	50,017	1,144,878	667,842	830,743	1,641,139	1,548,617	1,848,390	1,648,062	1,324,253
<i>Amur</i> ..	85,972	22,736	61,696	68,599	149,609	150,575	141,647	93,186	90,378	68,428
<i>Keora</i> ..	(b) 2,747	(b) 2,111	(b) 2,111	(b) 598	17,353	7,969	25,013	38,854	28,694	55,205
<i>Baen</i> ..	658,911	900,128	878,593	1,651,248	1,853,188	1,729,291	1,854,013	2,125,885	1,674,401	1,875,323
<i>Dhunda</i> ..	2,341	3,478	6,847	27,308	23,471	32,830	38,980	33,422	14,505	15,553
<i>Gengwa</i> ..	1,097,254	1,212,945	1,280,206	4,688,206	3,613,893	4,444,081	6,352,069	5,557,916	5,728,064	2,986,278
Other kinds ..	20,990	50,727	29,392	40,062	33,102	306,293	220,483	180,601	68,941	91,119
Total ..	2,291,831	2,240,109	3,403,723	7,143,863	6,521,359	8,312,178	10,180,822	9,878,254	9,253,045	6,416,159
(ii) <i>Goran</i> ..	858,519	1,084,366	1,131,357	1,869,604	1,085,122	635,243	701,345	1,035,118	792,637	867,795
(iii) Fuel—										
<i>Sundri</i> ..	287,744	426,201	458,286	199,642	297,553	220,988	252,745	243,611	527,139	557,751
Other kinds ..	2,719,020	2,955,332	2,433,901	2,085,179	2,352,752	1,939,239	1,976,988	1,969,664	1,873,220	1,403,673
Total ..	3,006,764	3,381,533	2,892,187	2,284,821	2,650,305	2,160,227	2,229,733	2,213,275	2,400,359	1,901,424
(iv) Minor Produce—	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
<i>Galpatta</i> ..	1,805,550	2,856,875	3,058,850	4,574,782	4,127,605	4,216,275	3,953,850	3,827,994	2,944,900	3,460,455
Honey ..	59	1,565	997	1,083	838	468	427	806	2,782	2,994
Wax ..	7	195	118	131	107	46	51	88	259	365
Other kinds ..	97,225	112,850	123,725	116,825	110,875	91,953	70,500	99,400	99,275	128,226
Total ..	1,902,841	2,971,485	3,183,690	4,692,821	4,239,425	4,308,742	4,024,828	3,928,288	3,047,216	3,592,040

\* Includes some *goran*.

(a) Separate figures not available; the yield has been included in "other kinds."  
 (b) Partial yield only, the rest included in other kinds  
 NOTE.—The apparent sudden rise in the yield of some types of timber and fuel in 1923-24, is due to the use of a new and more correct method of converting maund<sup>ms</sup> into cubic feet.

Past yield—continued.

**THE REMAINDER OF THE FORESTS IN THE KHULNA DISTRICT.**  
**Compartments Nos. 41 to 55 inclusive.**

Year.	1910-11.	1911-12.	1912-13.	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.	1919-20.
<b>Type of produce.</b>	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
(i) Timber—										
Sundri	54	..	..	3	59	32	381	6	122	28
Passur	(a)	(a)	(a)	(a)	(a)	44	6	..	598	64
Keora	(a)	(a)	(a)	(a)	93,741	189,677	(a)	..	..	175
Baen	(a)	(a)	(a)	(a)	4,725	13,234	159,077	119,855	227,682	244,190
Dhundal	(a)	(a)	(a)	(a)	15,771	10,451	9,800	7,328	15,750	39,572
Gengwa	(a)	(a)	(a)	(a)	22,317	9,417	20,677	19,985	523,118	607,644
Other kinds	263,584*	301,679*	37,284	259,924	233,032	5,273	7,540	41,931	5,669	25,156
Total	263,638*	301,679*	53,055	270,378	353,875	217,677	197,481	189,105	772,939	916,829
(ii) Goran	(a)	(a)	89,753	156,385	218,445	180,403	216,113	230,803	1,047,834	926,406
(iii) Fuel—										
Sundri	90,868	8	75	2	551,900	512,827	450,862	295,053	738,601	3
Other kinds	2,219,506*	1,636,869*	885,789	482,626	551,900	512,827	450,862	295,053	738,601	675,850
Total	2,310,374*	1,636,877*	885,864	482,628	551,900	512,827	450,862	295,053	738,601	675,853
(iv) Minor produce—	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
Golpatta	832,700	924,525	995,550	412,550	1,442,175	417,275	1,396,175	339,225	1,299,000	758,675
Honey	965	1,538	1,803	1,520	3,199	2,195	3,632	3,733	4,155	2,418
Wax	119	187	222	176	391	265	408	440	511	297
Other kinds	90,700	60,900	37,350	79,050	89,825	57,225	67,800	66,100	60,325	85,250
Total	924,484	987,150	1,034,925	493,296	1,535,590	476,960	1,468,015	409,498	1,363,991	846,640

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*Past yield of the remainder of the forests in the Khulna district (Compartments Nos. 41-55 inclusive)—concl'd.*

Year.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.	1928-29.	1929-30.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
<b>(i) Timber—</b>										
<i>Sundri</i>	24	133	89	122	477	549	156	181	595	..
<i>Passur</i>	150	118	106	257	38	7,714	14,541	306	1,319	..
<i>Keora</i>	76	42	..	50	19	1,199	7	..	47	..
<i>Baen</i>	273,137	319,186	323,232	572,422	609,156	757,768	478,062	749,602	882,330	705,253
<i>Dhunda</i>	11,687	19,009	16,080	25,150	50,409	155,545	110,236	46,783	125,363	6,735
<i>Gengwa</i>	326,433	313,307	401,657	1,820,504	3,422,950	3,839,720	3,258,359	2,872,068	1,388,133	1,537,558
Other kinds	11,463	23,428	13,611	28,007	399	24,941	34,046	30,686	68,257	34,530
Total	622,970	675,223	754,775	2,446,512	4,083,448	4,787,436	3,895,407	3,699,626	2,466,044	2,284,076
<b>(ii) Goran</b>	706,344	686,117	628,353	1,192,079	1,873,219	2,487,656	2,458,090	2,419,733	2,124,243	1,927,699
<b>(iii) Fuel—</b>										
<i>Sundri</i>	323,979	241,850	35,720	18,982	63,799	485,221	1,373	217,002	271,197	258,070
Other kinds	323,979	241,850	35,720	18,982	63,799	485,221	555,378	217,002	271,197	258,070
Total	647,958	483,700	71,440	37,964	127,598	970,442	1,928,751	434,004	542,394	516,140
<b>(iv) Minor produce—</b>										
<i>Golpatta</i>	779,900	585,250	1,313,675	697,175	1,636,438	1,028,275	1,820,263	690,104	1,159,850	257,275
Honey	695	2,612	3,002	3,708	3,205	3,718	3,686	4,197	5,530	1,851
Wax	87	325	362	439	372	458	432	523	693	233
Other kinds	86,100	82,575	76,975	145,925	128,750	137,875	127,725	162,300	164,825	70,135
Total	866,782	670,762	1,394,014	847,247	1,768,765	1,170,326	1,952,106	857,124	1,330,898	329,494

\* Includes some goran.

(a) Separate figures not available; the yield has been included in "other kinds."

(b) Partial yield only, the rest included in other kinds.

NOTE.—The apparent sudden rise in the yield of some types of timber and fuel in 1923-24 is due to the use of a new and more correct method of converting maundages into cubic feet.

Past yield—continued.

## THE RESERVED AND PROTECTED FORESTS OF THE 24-PARGANAS DISTRICT.

Compartments Nos. 56 to 75 inclusive.

Year.	1910-11.	1911-12.	1912-13.	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.	1919-20.
<b>Type of produce.</b>										
(i) Timber—										
Sundri	321	223	20	48	..	20	5	23	0	505
Passur	(a)	(a)	(a)	(a)	(a)	49	65	..	617	86
Keora	(a)	(a)	(a)	(a)	(a)	(a)	(a)	..	..	1
Baen	(a)	(a)	(a)	(a)	81,556	56,257	38,899	38,536	45,664	47,117
Dhundal	(a)	(a)	(a)	(a)	1,903	6,628	59,806	43,903	19,186	104,833
Tengua	(a)	(a)	1,335	1,664	2,620	3,891	2,760	5,871	3,126	15,648
Other kinds	600,887*	671,169*	39,894	170,852	181,632	21,554	35,613	26,770	21,119	41,426
Total	601,208*	671,392*	41,249	172,564	267,711	88,399	137,148	115,103	89,718	209,616
(ii) Goran	(a)	(a)	141,006	128,251	198,639	127,988	163,220	211,060	215,131	279,183
(iii) Fuel—										
Sundri	1,081,194*	1,061,733*	220,848	79,406	126,779	103,734	137,383	204,955	179,161	127,247
Other kinds	..	..	5	..	10	..	..	..	60	1
Total	1,081,194*	1,061,733*	220,853	79,406	126,789	103,734	137,383	204,955	179,221	127,248
(iv) Minor produce—										
Golpalla	129,225	124,875	36,850	272,225	46,275	195,350	53,000	147,200	27,525	156,200
Honey	3,890	3,892	2,728	2,809	3,185	2,482	2,551	3,897	4,052	3,404
Wax	480	473	339	354	369	298	294	450	495	430
Other kinds	443,575	382,975	220,225	219,150	216,700	118,950	116,300	141,300	107,550	134,775
Total	577,170	512,215	280,142	494,598	266,529	317,080	172,145	292,847	139,622	294,869

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Past yield of the reserved and protected forests of the 24-Parganas district (Compartments Nos. 56-75 inclusive)—concl'd.

Year.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.	1928-29.	1929-30.
<b>Type of produce.</b>										
(i) Timber—										
Sundri	236	1	1	..	18	16	3	927	..	512
Passur	63	197	37	..	5,897	102	175	88	..	985
Keora	1	6	..	4	12	10	..	25	..	1,256
Baen	47,701	75,829	87,638	99,315	203,858	71,405	97,062	134,209	97,545	205,339
Dhondal	105,883	108,506	154,981	489,827	449,810	85,283	277,237	316,006	87,775	198,639
Gengwa	34,927	7,154	5,855	12,443	13,569	36,431	72,058	71,476	16,002	112,978
Other kinds	24,736	51,852	85,369	169,673	258,007	35,202	94,097	65,291	67,237	88,755
Total	213,547	243,545	333,881	771,262	931,171	228,449	540,632	588,022	268,559	608,464
(ii) Goran—	315,020	377,942	403,768	600,513	811,032	300,589	288,139	389,270	333,860	641,222
(iii) Fuel—										
Sundri	100,853	63,836	14,918	8,988	141,922	55,782	6,836	1,881	836	3,643
Other kinds	100,853	63,830	14,918	8,988	141,922	55,782	124,281	86,130	111,067	112,497
Total							131,117	88,011	111,903	116,140
(iv) Minor produce—										
Golpatta	13,075	54,525	27,125	188,575	30,950	223,050	26,912	115,550	3,400	378,600
Honey	16	3,846	3,090	3,668	4,196	4,916	4,020	3,284	5,454	5,618
Wax	2	467	368	393	449	558	443	393	615	696
Other kinds	140,325	151,375	164,950	174,050	240,300	190,125	107,200	209,000	137,850	242,990
Total	153,418	210,213	195,533	366,086	275,895	418,649	138,575	328,227	147,319	627,904

\* Includes some goran.

NOTE.—The apparent sudden rise in the yield of some types of timber and fuel in 1923-24, is due to the use of a new and more correct method of converting maundages into cubic feet.

(a) Separate figures not available; the yield has been included in "other kinds."

(b) Partial yield only, the rest included in other kinds.

## 115. Past total annual yields from the reserved and protected forests of the division.—

Year or period.	Average annual figures for—				1918-19.
	1879-80 to 1892-93.	1893-94 to 1902-03.	1903-04 to 1909-10.	1910-11.	
Type of produce.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
(i) Timber—					
<i>Sundri</i> (including <i>passur</i> ) ..	3,023,928	2,415,135	1,199,785	1,044,705	821,157
<i>Amur</i> ..	34,511	1,717	(a)	(a)	50,841
<i>Keora</i> ..	361,048	84,348	(b) 25,550	(a)	(b) 5,656
<i>Baen</i> ..	(a)	(a)	(a)	(a)	(b) 605,663
<i>Dhundal</i> ..	(a)	(a)	(a)	(a)	632,214
<i>Gengwa</i> ..	(a)	(a)	(a)	(a)	79,231
Other kinds ..	441,824	528,861	2,002,104*	(b) 12,115	(b) 25,856
Total ..	3,861,311	3,030,061	3,227,439*	1,914,733	1,734,246
	(b)	4,555,038	(b)	1,383,835	3,306,987
(ii) <i>Goran</i> ..	1,151,102		1,138,623		
(iii) Fuel—					
<i>Sundri</i> ..	9,328,149*	1,811,119	921,877	2,363,057	1,313,600
Other kinds ..	9,328,149*	7,673,481	10,687,730*	4,476,552	3,227,233
Total ..		9,484,600	11,609,607*	6,839,609	4,540,833
	Mds.	Mds.	Mds.	Mds.	Mds.
(iv) Minor produce—					
<i>Golpatta</i> ..	3,108,826	3,893,887	4,268,659	4,620,530	4,001,845
Honey ..		7,794	8,191	8,125	9,824
Wax ..	9,432			969	961
Other kinds ..	409,308	536,526	409,240	375,125	335,675
Total ..	3,527,566	4,438,207	4,686,090	5,004,749	4,348,491
				4,333,711	4,735,837

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Past total annual yields from the reserved and protected forests of the division—concl'd.

Year.	1919-20.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.	1928-29.	1929-30.
<b>Type of produce.</b>	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
(i) Timber—											
Sundri (including passur) ..	960,746	424,089	50,466	1,145,111	668,221	837,173	1,649,520	1,563,492	1,849,892	1,649,976	1,325,750
Amur ..	102,502	85,973	22,736	61,696	68,599	149,609	150,576	141,647	93,186	90,379	68,428
Keora ..	(b) 7,997	(b) 2,824	(b) 126	(b) 2,111	(b) 652	17,384	9,178	25,020	38,879	28,741	56,461
Baen ..	901,908	979,749	1,295,143	1,289,463	2,322,985	2,666,202	2,558,464	2,429,137	3,009,696	2,654,276	2,785,915
Dhundal ..	162,210	119,911	130,993	177,908	542,285	523,690	273,658	426,453	396,211	227,643	220,927
Gengwa ..	1,734,084	1,458,614	1,533,406	1,687,718	6,521,153	7,050,412	8,320,232	9,682,486	8,501,460	7,132,199	4,636,814
Other kinds ..	96,747	57,188	126,007	128,372	237,742	291,508	366,435	348,626	276,578	204,434	214,404
Total ..	3,966,194	3,128,348	3,158,877	4,492,379	10,361,637	11,535,978	13,328,063	14,616,861	14,165,902	11,987,648	9,308,699
(ii) Goran ..	1,944,079	1,879,883	2,148,425	2,163,478	3,662,196	3,769,373	3,423,488	3,447,574	3,844,121	3,250,740	3,436,716
(iii) Fuel—											
Sundri ..	405,479	287,744	426,201	458,286	199,642	297,553	220,988	260,954	245,492	527,975	561,394
Other kinds ..	3,318,297	3,143,852	3,261,018	2,484,539	2,113,149	2,558,473	2,480,242	2,656,647	2,272,796	2,255,484	1,774,240
Total ..	3,723,776	3,431,596	3,687,219	2,942,825	2,312,791	2,856,026	2,701,230	2,917,601	2,518,288	2,783,459	2,335,634
(iv) Minor produce—	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
Golpatta ..	5,054,950	2,598,525	3,496,650	4,399,650	5,460,532	5,794,993	5,467,600	5,801,025	4,633,648	4,108,150	4,096,330
Honey ..	6,938	770	8,023	7,089	8,459	8,239	9,102	8,133	8,287	13,766	10,463
Wax ..	853	96	987	848	963	928	1,062	926	1,004	1,567	1,294
Other kinds ..	321,000	323,650	346,800	365,650	436,800	479,925	419,953	305,425	470,700	401,950	441,351†
Total ..	5,383,741	2,923,041	3,852,460	4,773,237	5,906,754	6,284,085	5,897,717	6,115,509	5,113,639	4,525,433	4,549,438

\* Includes some goran.

† In addition to this figure, 13,029 water lizard skins, 840 python skins and 41 crocodile skins were exported in 1929-30; these skins yielded a revenue of Rs. 10,772.

(a) Separate figures not available; the yield has been included in "other kinds."

(b) Partial yield only, the rest included in other kinds.

Note.—The apparent sudden rise in the yield of some types of timber and fuel in 1923-24, is due to the use of a new and more correct method of converting maundages into cubic feet.

116. **Leased lands.**—In addition, a considerable quantity of forest produce has been removed from the lands leased under the rules of 1879 and subsequent rules; full royalty rates have been charged on this produce (*vide* paragraph 33). The following statement gives the annual export since 1910-11:—

**PAST ANNUAL EXPORTS FROM THE LANDS LEASED UNDER THE RULES OF 1879.**

Year.	1910-11.	1911-12.	1912-13.	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.	1919-20.
<b>Type of produce.</b>	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
(i) Timber—										
<i>Sundri</i> ..	7,831	153	525	929	788	940	612	131	416	634
<i>Passur</i> ..	(a) ..	(a) ..	6,518	11,330	17,557	6,735	9,667	1,728	3,985	6,110
<i>Keora</i> ..	(a) ..	(a) ..	(a) ..	(a) ..	(a) ..	(a) ..	(a) ..	..	..	88
<i>Baer</i> ..	(a) ..	(a) ..	(a) ..	(a) ..	88,572	148,022	89,659	56,481	59,916	52,741
<i>Gengwa</i> ..	(a) ..	(a) ..	(a) ..	(a) ..	(a) ..	(a) ..	(a) ..	(a) ..	1,208	4,642
Other kinds ..	74,567*	86,084*	15,420	127,211	180,212	15,623	4,828	2,132	5,689	3,741
Total ..	82,398*	86,237*	22,463	139,470	287,129	171,320	104,766	60,472	71,214	67,956
(ii) <i>Goran</i> ..	(a) ..	(a) ..	147,897	244,671	230,606	130,790	162,552	56,766	70,022	61,097
(iii) Fuel—										
<i>Sundri</i> ..	4,768	20,181	1,662	3,587	16,406	..	..	..	1,619	..
Other kinds ..	1,177,220*	783,387*	1,049,782	1,148,650	521,063	373,143	301,087	170,444	268,669	283,631
Total ..	1,181,994*	812,568*	1,051,444	1,152,237	537,469	373,143	301,087	176,444	270,288	283,631
(iv) Minor produce—	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
<i>Golpatia</i> ..	125	775	..	..	1,600	..	..	..	..	..
Honey ..	21	4	..	4	33	18	..	..	..	..
Wax ..	2	1	..	1	3	1	..	..	..	..
Other kinds ..	46,525	25,650	19,075	36,400	16,850	9,200	3,200	825	4,975	1,175
Total ..	46,673	26,430	19,075	36,405	18,486	9,219	3,200	825	4,975	1,175

Continued over page—

*Past annual exports from the lands leased under the rules of 1879—concl'd.*

Year.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.	1928-29.	1929-30.
<b>Type of produce.</b>										
(i) Timber—										
<i>Sundri</i>	109	11,834	66	119	5,795	7,323	14,405	9,232	6,883	559
<i>Passur</i>	2,450	219	11,280	15,256	1,150	1,150	125,769	168,430	3,300	4,000
<i>Keora</i>	26,819	29,443	438	76,238	84,385	15,321	21,528	68,256	119,154	102,923
<i>Baen</i>	20,066	1,298	54,600	1,945	2,093	14,008	4,606	1,150	103,113	128,054
<i>Genqua</i>	4,303	52,282	1,210	86,321	103,750	6,291	166,308	247,068	1,143	100
Other kinds	53,747	95,076	46,835	179,879	196,023	44,093	186,167	152,534	233,593	235,636
Total	102,200	129,106	147,984	173,433	113,900	218,600	152,534	152,534	152,467	149,303
(ii) <i>Goran</i>										
(iii) Fuel—										
<i>Sundri</i>	3,194	9,756	11,288	6,030	136,799	6,836	1,373	1,134	687	211,696
Other kinds	237,519	69,816	249,943	134,979	136,799	384,518	393,362	353,739	192,458	211,696
Total	240,713	79,572	261,231	141,009	136,799	391,354	394,735	354,873	193,145	211,696
(iv) Minor produce—										
<i>Golpatta</i>		Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
Honey	..	6,375	1,575	..	100	2,025	775	..	25	..
Wax	..	..	211	..	..	..	..	..	..	..
Other kinds	300	15,725	2,175	1,300	50	21,325	3,725	1,025	625	2,650
Total	300	22,100	3,987	1,300	150	23,350	4,500	1,025	650	2,650

\* Includes some *goran*.

(a) Separate figures not available; the yield has been included in "other kinds."

NOTE.—The apparent sudden rise in the yield of some types of timber and fuel in 1923-24, is due to the use of a new and more correct method of converting maundages into cubic feet. (b) Partial yield only, the rest included in other kinds.

## Past Revenue and Expenditure.

117. The following statement gives the revenue and expenditure of preceding years :—

Year or period.	Revenue.	Expenditure.			Surplus.	Percentage of expenditure to revenue.
		A.	B.	Total.		
	Rs.	Rs.	Rs.	Rs.	Rs.	Per cent.
1875-76 .. ..	32,722	6,843	9,235	16,078	16,644	49
Average annual figures for—						
1876-77 to 1892-93 .. ..	3,27,183	37,465	30,009	67,474	2,59,709	21
1893-94 to 1902-03 (Mr. Heinig's Plan) .. ..	5,57,728	60,092	41,092	1,01,184	4,56,544	18
1903-04 to 1911-12 (The working schemes of Mr. Lloyd and Sir H. Farrington) .. ..	5,09,330	1,26,142	59,346	1,85,488	3,23,842	36
The currency of Mr. Trafford's Plan—						
1912-13 .. ..	5,50,950	1,09,166	72,206	1,81,372	3,69,578	33
1913-14 .. ..	7,64,636	1,07,353	76,814	1,84,167	5,80,469	24
1914-15 .. ..	5,68,711	1,19,263	80,677	1,99,940	3,68,771	35
1915-16 .. ..	4,76,922	88,862	75,392	1,64,254	3,12,668	34
1916-17 .. ..	6,23,056	1,02,207	75,911	1,78,118	4,44,938	29
1917-18 .. ..	6,00,207	1,25,073	70,883	1,95,956	4,04,251	33
1918-19 .. ..	6,64,748	1,30,436	58,062	1,88,498	4,76,250	28
1919-20 .. ..	7,29,962	1,12,905	56,178	1,69,083	5,60,879	23
1920-21 .. ..	5,97,891	1,28,059	47,400	1,75,459	4,22,432	29
1921-22 .. ..	5,54,913	1,23,435	70,326	1,93,761	3,61,152	35
1922-23 .. ..	6,99,921	1,33,019	90,362	2,23,381	4,76,540	32
1923-24 .. ..	7,50,915	1,31,646	95,621	2,27,267	5,23,648	30
1924-25 .. ..	8,96,820	1,58,859	98,213	2,57,072	6,39,748	29
1925-26 .. ..	10,33,737	1,47,018	1,01,676	2,48,694	7,85,043	24
1926-27 .. ..	10,29,980	1,41,422	1,10,974	2,52,396	7,77,584	25
1927-28 .. ..	9,44,775	1,50,443	1,13,717	2,64,160	6,80,615	28
1928-29 .. ..	8,79,203	2,08,826	1,06,444	3,15,270	5,63,933	36
1929-30 .. ..	8,98,566	1,50,405	1,01,892	2,52,297	6,46,269	28
Total for 1912-13 to 1929-30	132,65,913	23,68,397	15,02,748	38,71,145	93,94,768	
Annual average .. ..	7,36,995	1,31,578	83,486	2,15,064	5,21,931	29

The gradual rise in the standard of current expenditure since 1912, has been due to the increase in the cost of the upkeep of launches, boats, etc., and the gradual rise in prices, rates of labour and the rates of pay of the subordinate establishments. Since 1924-25, a considerable amount of indirect expenditure has been incurred on the field-work of this plan (*vide* paragraph 167 of Part II). The *gengwa* coupe which was started in the Eastern Working Circle in 1927, is also responsible for a certain amount of extra expenditure. The sudden rise in 1928-29 is abnormal; it was due to the renewal of the hull of S.L. "Harrier" at a cost of Rs. 54,750.

118. In addition, the following capital expenditure has been incurred :—

	Rs.
1926-27 .. ..	23,505
1927-28 .. ..	25,692
1928-29 .. ..	12,105
1929-30 .. ..	9,904
Total .. ..	71,206

Of this amount, Rs. 19,419 has been spent on the compilation of this plan, Rs. 31,566 on the construction of buildings, Rs. 13,438 on the construction of boats and Rs. 6,783 on permanent stores, sample plots, etc. Before 1926, there was no differentiation between capital and current expenditure.



## Past revenue on the different types of produce—concl'd.

Period or year.	1918-19.	1919-20.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.	1928-29.	1929-30.
Type of produce.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(i) Timber—												
<i>Sundri</i> (including <i>passour</i> )	1,14,988	1,39,476	1,93,806	12,724	1,12,728	84,657	1,70,122	2,66,809	2,14,585	1,29,460	1,23,366	1,68,022
<i>Amar</i>	3,204	5,798	5,621	1,310	3,522	1,853	4,161	4,863	4,570	3,047	2,932	2,227
<i>Kaora</i>	(b)64	(b)7	(b)53	(b) 48	(b)50	(a) . .	(b)98	(b)74	(b) 86	4,840	3,205	6,980
<i>Baen</i>	38,084	49,075	62,175	74,806	69,850	83,558	83,270	87,931	89,401	1,02,719	90,458	92,641
<i>Dhundal</i>	15,228	7,860	5,977	6,900	7,625	15,908	14,963	13,320	12,984	13,412	8,758	6,161
<i>Gengwa</i>	95,490	90,018	1,11,335	82,332	92,589*	1,07,164	1,25,335	1,58,950	1,84,419	1,83,105	1,74,262	1,27,519
Other kinds	2,194	4,203	3,531	7,461	8,793	7,532	3,238	8,557	9,497	4,641	4,752	6,861
Total	2,69,252	2,96,437	3,82,498	1,85,581	2,95,157	3,00,672	4,01,187	5,40,504	5,15,542	4,41,224	4,07,733	4,10,411
(ii) <i>Goran</i>	1,50,214	1,25,276	1,52,347	1,43,707	1,45,744	1,58,584	1,67,212	1,52,541	1,57,113	1,79,957	1,52,971	1,67,504
(iii) Fuel—												
<i>Sundri</i>	20,368	10,438	7,845	11,420	10,706	6,898	9,938	7,952	8,761	8,261	16,892	17,978
Other kinds	60,461	55,372	57,702	50,692	37,225	39,839	46,121	48,601	52,185	51,619	48,187	45,113
Total	80,829	65,810	65,547	62,112	47,931	46,737	56,059	56,553	60,946	59,880	65,079	63,091
(iv) Minor produce—												
<i>Golpalla</i>	1,45,796	1,67,678	1,40,656	1,23,366	1,54,835	1,91,916	2,13,128	2,19,420	2,32,561	1,85,955	1,64,797	1,64,435
Honey	15,735	14,911	7,159	12,035	10,952	12,700	12,359	13,668	12,206	12,442	20,656	15,848
Wax	4,943	4,883	2,335	3,949	3,501	3,855	3,713	4,739	4,060	4,184	6,907	5,246
Other kinds	8,211	8,807	10,950	10,317	10,419	12,561	13,945	14,706	9,733	15,581	15,554	24,684
Total	1,74,685	1,96,279	1,61,100	1,49,667	1,79,707	2,21,032	2,43,145	2,52,533	2,58,560	2,18,162	2,07,914	2,10,213
Miscellaneous Revenue	22,412	14,427	14,316	13,846	31,382	23,890	29,217	31,606	37,820	45,552	45,506	47,347
Total Revenue	6,97,392	6,98,229	7,75,808	5,54,913	6,99,921	7,50,915	8,96,820	10,33,737	10,29,981	9,44,775	8,79,203	8,98,566

\* Includes *goran*.

(a) Separate figures not available; the revenue has been included in "other kinds."

(b) Partial revenue only, the rest included in "other kinds."

(c) Details not available for this year.



## CHAPTER VI.

## STATISTICS OF GROWTH AND YIELD.

## Sample and Experimental Plots

120. A list of the sample and experimental plots in the division will be found in Appendix IV; they are under the control of the Silviculturist, Bengal.

121. **Sundri** (*Heritiera minor*, or *H. fomes*).—Four girth increment sample plots of *sundri* were laid out in 1893, and an additional four plots were started in 1905, two more in 1907 and 1909, and two in 1911. The girths in these plots were measured to the nearest sixteenth of an inch at 4 feet 6 inches from the ground. During the season 1911-12, it was found that further measurements on these plots became unsatisfactory owing to the development of buttress growth, and the plots were abandoned. In 1916-17, ten fresh sample plots were laid out by Mr. Gent; four of these were laid out on, or near, the sites of old plots. In order to obviate the previous difficulty experienced with buttress growth, the girth measurements were made at a height of 12 feet, instead of 4 feet 6 inches. In these, and all subsequent plots, measurements were made to the nearest tenth of an inch. A measurement was made in 1922, when both girths and diameters were measured. At the last remeasurement in 1926, measurements were made of the diameter only, both at 12 feet from the base, and at or about 4 feet 6 inches from the base. The measurements of 1922 give the relation between girths and diameters at 12 feet. One plot, sample plot No. 6, was totalled up by the writer, and the average factor came to 3.17, very near the theoretical relation. The measurements of 1926 give the relation between the diameters at 4 feet 6 inches and 12 feet, this has been worked out by the Imperial Silviculturist, who has converted the relation to an algebraical equation, which is given in the foot-note to the *sundri* figures in Appendix IV. It was found that the existing sample plots were typical of only the best quality *sundri* forests; consequently, in 1928, a further *sundri* sample plot, No. 18, was formed in the Hansraj gang, close to sample plot No. 9; also, odd *sundri* standards were measured in the plots for *goran* (*Ceriops Roxburghiana*), which were formed in 1926. It is too early, yet, to obtain any reliable results from a remeasurement of the trees in these latter plots. Diameter increment figures were calculated by the Silviculturist, Bengal, from the plots formed in the season 1916-17. These are given in Appendix IV. They have been converted by the writer from increments of the diameter at 12 feet from base, to increments at 4 feet 6 inches from the base. In addition, for the purpose of this plan, diameter increment figures, converted from girth increments, have been calculated from the more reliable measurements made on the eight old plots, laid out in 1893 and 1905. (See Appendix IV.) No knowledge has yet been obtained of the rate of growth from the seedling up to 3 inches diameter breast height, and the number of measurements for the more mature diameters are deficient. More sample plots or diameter increment plots are needed, also, in the moderately salt-water forests of 20 to 35 feet height growth.

122. **Other species.**—Up to the present, very little knowledge has been obtained of the rate of growth of species other than *sundri*. In 1926 and 1928, Mr. C. K. Homfray, the present Silviculturist of Bengal, laid out and measured several sample and experimental plots of *goran* (*Ceriops Roxburghiana*), *gengwa* (*Excoecaria Agallocha*), and *keora* (*Sonneratia apetala*). All species occurring in these new plots have been measured; in this way, a few trees of *passur* (*Carapa moluccensis*), and one or two specimens of *Amoora cucullata* and *Bruguiera gymnorhiza*, have been included. Valuable information will be available from these plots in a few years' time; but still more plots are needed, particularly of the better qualities of *gengwa* and *passur*. These two species do not grow gregariously in the better quality forests, and it is probable that a linear sample plot of miscellaneous growth, will give the most information for the least expense and labour. During the last year or so, further creation of new

plots has been stopped, owing to the shortage both of responsible staff in the division to look after them, and of the silvicultural staff available for their remeasurements.

123. Two experimental plots of *goran* were laid out in 1926. Experimental Plot No. 1 has proved that, if all the shoots on one root-stock are clear-felled, the root dies and forms a blank. In Experimental Plot No. 2, all the sticks above 1 inch in diameter at 3 feet along the stem were felled. It was found that the remaining shoots of under 1 inch in diameter developed vigorously, and the root-stocks remained quite healthy. All the *goran* plots formed in 1926 were remeasured by Mr. S. A. Yusuf, Assistant Conservator of Forests, in August 1928. From these remeasurements, it was possible to obtain an idea of the rate of growth of the *goran* (see figures in Appendix IV), but the increments of the standards of *gengwa*, *sundri* and *passur*, were far too irregular to be of any use at all. The other plots have not been remeasured yet.

124. Two areas were fenced in by the divisional staff in 1927 in order to study the rate of seedling growth, and the effect of protection against deer. Observations have been made on the rate of growth of young poles of *keora* and *baen* (*Avicennia officinalis*), growing around the compound at Koikhali Revenue Station. Up to the present, the measurements for *keora* show that it takes 12 years for a sapling of 4 inches girth to reach 18 inches girth, and 13 years for it to grow from 8 feet 6 inches to 32 feet in height. The *baen* has been badly attacked by a borer, consequently no reliable estimate of the rate of growth can be deduced from their measurements. A few *golpatta* fruits (*Nipa fruticans*), were sown on old timber ghats in the Mara Passar khal in March 1925. The last observations on these sowings were made in May 1929. On one *ghat*, the average number of leaves per plant was 7·8, and the average height from the tip of the highest standing leaf to the ground, was 5 feet 7 inches; on the other *ghat*, the corresponding averages were 6·0 and 8 feet respectively. At this rate, after another year's growth, namely, five years after sowing, the plants should be bearing a fairly full crop of exploitable leaves.

#### Rough Estimates of Rate of Growth by counting Annual Rings.

125. **Gengwa.**—In order to obtain some idea of the rate of growth of *gengwa*, 77 trees of sizes varying from 8 inches to 18 inches diameter at breast height were felled in Compartment 23, and their annual rings counted. The average result worked out to 10·1 inches in 73·6 years. Particulars of these measurements may be found in the forest journal of the division; the forest is of second quality in the locality in which these trees were measured. According to these figures, therefore, second quality *gengwa* should attain a diameter of 10 inches in 74 years. Unless a very large number of trees are counted in each diameter class, ring-counting is very unreliable, especially with *gengwa* whose annual rings are not at all distinct. Consequently, for the purpose of this plan, it has been estimated that the second quality *gengwa* attains a diameter of 10 inches in 100 years.

126. **Keora.**—Ring-counting was carried out on 99 stumps, of which 55 were in Compartment No. 11, 34 in Compartment No. 7, and 10 in Compartment No. 13; the measurements therefore refer to fresh-water *keora*. The average result worked out to 22·4 inches of diameter in 58·1 years. Dividing the measurements into three diameter classes, the results were as follows:—

Diameter class.	Number of trees.	Average diameter.	Average number of annual rings.
Inches.		Inches.	Years.
10 to 19 .. .. .	36	15·6	47·9
19 to 27 .. .. .	41	22·5	61·0
27, and over .. .. .	22	32·5	69·5

The details of these calculations may be found in the forest journal. The results show extraordinarily rapid growth, and tally fairly well with the data regarding sapling growth given in paragraph 124. Nevertheless, for the same reasons as those given in the previous paragraph on *gengwa*, the foregoing deductions must be considered unreliable. For the purpose of this plan, therefore, a slower growth has been assumed; namely, that fresh-water *keora* attains a diameter of 25 inches in 85 years.

127. **Baen.**—Ring-countings have been made on 48 stumps of felled *baen* trees of diameters varying from 12.5 inches to 24.5 inches at breast height; with the exception of two, all these measurements were made in Compartment No. 11, a fresh water area. The average result worked out to 17.0 inches of diameter in 138.5 years. The average of the ten largest trees measured, gave a result of 21.4 inches diameter in 163.3 years. These results show very slow growth; but owing to the depredations of a defoliator which infests this species, it is very probable that it is a common occurrence for *baen* to form two rings in one year. However, in the absence of more reliable information, these figures have been used as a basis for estimating the exploitable ages given in paragraph 42 of Part II.

### Volume Tables.

128. **Tables prepared for this plan.**—During the field-work for this plan, sample trees of the principal species were felled in various parts of the forests, and their volumes were measured. The sample trees were grouped together according to their species, quality and diameter class, and volume curves were prepared from the resulting averages. These curves were converted into volume tables, which are given in Appendix V. Volume tables were prepared in this way for *sundri*, *gengwa*, *passur*, *dhundal*, *baen*, *keora* (fresh-water type), *white baen*, *goran* and *math goran*. No sample trees of other species were felled, but in order to gain some idea of the volume of their growing stock, estimated volume curves were prepared for *keora* (salt-water type), *kankra* (*Bruquiera gymnorhiza*), *amur* (*Amoora cucullata*), *khalshi*, (*Ægiceras majus*), *kirpa* (*Lumnitzera racemosa*), *tora* (*Ægialitis rotundifolia*), and for "miscellaneous" or "other species." These curves have been converted into tables, which have also been included in Appendix V; they were estimated by deducing what the probable shapes of the curves would be, in comparison to those already obtained by measurements of sample trees for the nine types previously mentioned.

129. **Tables for *sundri* published in the Indian Forests Records.**—Other than those prepared from measurements taken during the field-work of this plan, the only volume tables available are those for *sundri* published in Volume XIII, Part IV of the Indian Forest Records, 1928. The main subject of the bulletin is volume tables for commercial timber, compiled from measurements taken by the Dehra Dun staff, on the *sundri* coupes of 1926-27. The tables have been classified into fresh-water and salt-water *sundri*, and both types have been divided into ten feet height classes. At each remeasurement of the sample plots, various sample trees have been felled and measured. From the data thus obtained, standard volume tables of all material down to 2 inches diameter over bark, have been prepared for the fresh-water *sundri*, and included in the same bulletin. Among the ten plots formed in 1916-17, only one was of the salt-water type; consequently there were insufficient data to form similar standard volume tables for salt-water *sundri*. It should be noted that the salt-water type, referred to in the bulletin, applies approximately to the forests on or near the boundary between the fresh-water and moderately salt-water zones described in paragraphs 39 to 44 inclusive; it does not apply to the forests of the salt-water zone as classified in this plan.

130. The classification used for the preparation of these tables was not suitable for the calculations in this plan, but the figures tally fairly well with those for *sundri* given in Appendix V. The average timber volume for all heights in Table 13 of the bulletin, comes somewhere between the figures for qualities I and II as prepared for this plan. This is what one would expect; the locality in which measurements were taken for the bulletin was Compartment 13, which contains both first and second quality forest. The volumes for the smaller sizes are larger in Appendix V, because the particular market, namely, Barisal, for which the timber in Compartment 13 was being felled, did not exploit the smaller sizes for timber to the same extent as in the old subsidiary thinning coupe, and to the extent that is expected by local sale under the prescriptions of this plan.

**PART II.**

**Future Management Discussed and Prescribed.**

## CHAPTER I.

### BASIS OF PROPOSALS.

#### The General Objects of Management.

1. The main purpose of the management of these forests is the production of timber, fuel and thatching material, and their perpetual supply at reasonable rates to south-eastern Bengal, notably the Calcutta, 24-Parganas, Khulna, Barisal, and Jessore districts. It is also necessary to grow sufficiently large sized *sundri* for sawing into planks for boats, and sufficiently large sized *gengwa* for use in match-making and box-planking. Under the former system of management, the supply, or rather the possibility of most types of forest produce for the above purposes, was not equal to the demand.

2. The second purpose of the management is the promotion of trade in forest produce of this division, for which there is, as yet, either no demand, or of which there is an excess of supply over the demand. No prescription for this have been made, except to allow *sundri* timber to be used more freely for local uses, and thus encourage the utilisation of the excess in smaller sizes for house-posts and fuel; but the extension of markets for this, and other types of produce, will depend largely on the efforts of local officers, rather than on working plan prescriptions. Of the forest produce which is so far not utilised, may be mentioned *bhola* (*Hibiscus tiliaceus*) whose bark supplies a good fibre, and *kewa kanta* (*Pandanus foetidus cum odoratissimus*) whose eaves, after removing the thorns, are made into rush mats in the Irawaddy Delta.

3. A further justification for the maintenance of the Sundarbans Forests, is that it protects the cultivated lands in the interior from devastating storm waves, such as have happened in the past in Saugar Island of the 24-Parganas district, and in the Sarankhola thana of the Khulna district. Both these areas were too near the sea to have been colonized. Also, the clearing of the forests and the *bunding* of lands for cultivation, deprives the tidal rivers and creeks of their natural spill areas; the scour during the ebb tide is stopped, and the waterways silt up. Thus, navigation is impeded, and transport becomes more difficult and expensive. In addition, *bunding* impedes the natural deposit of silt on the lands inside such *bunds*, preventing its gradual rise in level, and thus promoting unhealthy and water-logged tracts, such as may be seen in the neighbourhood of Kaliganj.

4. In so far as is consistent with the above objects, as large a surplus as possible, should be obtained from the division, for the benefit of Government revenue.

#### The Particular Objects of this Plan.

5. As already explained in Chapter V of Part I, the stocking of the miscellaneous species is in a very depleted condition, owing to continual unregulated felling in past years. A glance at the figures for past outturn and revenue in Chapter V of Part I, clearly shows the absurdity of continuing the present system of management of confining felling control and proper silvicultural treatment to the five species, *sundri*, *passur*, *amur*, *keora* and *kankra*. For this reason, the principal object of the prescriptions of this plan is to economise in utilisation by concentrating the felling of not only *sundri*, *passur*, etc., but of all important types of forest produce, in coupes. The revenue station and permit system, hitherto used for most kinds of produce, will be discontinued. By this means, the tremendous waste which occurs with unregulated felling can be prevented; in addition, it will be possible to give proper silvicultural treatment to all important species, and to regulate their output according to the possibility of the forests. To do this without penalising the owners of small local boats, a number of coupes have been prescribed all over the division, instead of

concentrating the coupe fellings in one locality as heretofore. This should tend, also, to promote the local use of *sundri* and *passur* both for timber and fuel, without lessening the degree of control under the former plan; this, in its turn, will lessen the strain of the demand on the other species which have been overcut.

6. By encouraging the local demand for small sized *sundri* and *passur*, it is hoped that, eventually, the excess of the pole age gradations in these species will be eliminated, and a normal proportion of age gradations obtained. The check on the cutting of miscellaneous species and their proper silvicultural treatment, will allow their depleted stocking to recover gradually, and thus assure their adequate supply in future years. At the same time, by more detailed management, economy in utilisation, and the exploitation of the *pukka sundri* and *passur* in the coupes of the western forests, which have not been utilised since 1903-04, there will be a large increase in the outturn and revenue possibility of the division.

7. Under the organisation prescribed, it will be possible to make planting and other silvicultural experiments under efficient control, with a view to eventual filling up of blanks, and the improvement of the growing stock in future years.

### Method of Valuation of the Forests, and General Results of the Reconnaissance made.

8. **Computation of areas.**—Owing to the fact that the whole area is divided up by a close network of creeks and rivers which are broader at high tide than they are at full ebb, the calculation of the areas caused some difficulty. In the area statements of this plan, *land* means areas above the usual high tide level, or areas below high tide level which carry forest growth; *char* means land below high tide level, but above low tide level, which is without forest growth. During the lineal enumeration, the enumerators took a note of the length or width of each small *khal* falling within their enumeration line; these measurements were added up for each compartment, and the estimated area of *small khals and creeks* was worked out by proportion; the details of these calculations are given in Appendix VIII. The muddy banks of *small khals* below high tide level, were classed as *khal*. The total area enclosed by the forest boundaries was calculated, and agreed with the table of areas of 5 minute quadrilaterals of latitude and longitude on page 23 of Part III, Topographical Survey Tables (5th edition, revised and extended) published by the Survey of India. From this total area, was subtracted the areas of *land, char, and small khals*; the result thus obtained gave the area of *large khals, rivers and estuaries*. *Khals* forming compartment boundaries were classed as *large khals*; other waterways included in this category are listed in Appendix VIII.

9. The maps used were 2 inch enlargements of the 1 inch sheets prepared from the survey of 1905-1908. As far as possible, these maps were revised to show subsequent large accretions and erosions; these revisions were made with the aid of the enumeration lines, by rough triangulation, or by eye during the field-work for the plan. The areas of *land, char, and small khals* have been computed, compartment by compartment, with a planimeter. First of all, the area of each type of forest according to the stock maps was calculated, and then their total was checked by planimentering around the whole compartment. The result of this checking showed small differences varying from .010 per cent. to .342 per cent. for each compartment; the sum total of all the compartments added together, differed only by 151 acres in a total area of 1,640,079 acres; consequently, the area figures obtained are considered as accurate as it is possible to make them without a fresh survey.

10. **Enumerations.**—Linear valuations, in east and west lines, have been made throughout the forests in the division. The lines were only 11 feet wide, and were made one mile apart in the forests of the Khulna district, and one and a half miles apart in the poorer forests of the 24-Parganas district. On these lines, all species of trees of 3 inches diameter and over were enumerated in 1 inch diameter classes up to 18 inches diameter; for trees exceeding this diameter, such as large sized *keora*, (*Sonneratia apetala*) and *baen* (*Avicennia officinalis*), 3 inches diameter classes were used. Species such as *goran* (*Ceriops Roxburghiana*), *amur* (*Amoora cucullata*), *singra* (*Cynometra ramiflora*), *khalshi* (*Ægiceras majus*), etc., are utilised in small sizes. In order to obtain an approximation of their stocking, at every 5 chains along the lines,

an 11 foot square (i.e., 121 square feet) was measured, in which these species were enumerated down to 1 inch diameter. In the 24-Parganas district, where all the trees are small, all species down to 1 inch diameter were enumerated in these 11 foot squares 5 chains apart; also, in compartments Nos. 60 to 75 inclusive, the minimum diameter of trees measured along the lines was lowered to 2 inches. Dead trees were not enumerated; living trees whose unsoundness was apparent were counted, but listed separately.

11. To ensure accuracy with such a small width of line, the direction was first staked out by a compassman, using a prismatic compass with 2 or 3 coolies; then a thin rope of 1 inch circumference and of one chain length (when wet) was laid on the line. With the aid of a stick of 5½ feet in length, it was easy for the enumerator to ascertain exactly what trees should be included in the line, and what trees should be excluded. Particular care was taken with regard to this, in order that more trees were not included in the enumeration than actually fell within the limits of the line; if the base of a tree was less than half within the line, it was excluded. When the work first started, only reliable Deputy Rangers and Foresters were used as enumerators; later on, the more reliable of the temporary men in the Working Plan Camp were put on this work also. The enumerations were recorded in the field-books, chain by chain; a piece of paper with the number of the chain printed on it, was placed in a cleft stick at the end of each chain, and each tree enumerated was dabbed with cheap red paint. These precautions made it possible for the lines to be checked at any point, and facilitated stock mapping. Out of the 2,122 miles 69 chains of line enumerated, only 25 miles 54 chains were checked, but this checking was made in various places over the whole forests; on every day during the field-work, a few chains were checked, and an enumerator never knew on which part of his line, the inspecting officer would start. The results of this checking are considered, therefore, to indicate the degree of accuracy of the average lines; they are given in Appendix VII. The error in total volume is only 0·11 per cent. for all species, and for *sundri* and *gengwa* separately, 0·96 per cent. and 2·20 per cent. respectively.

12. **Quality classes.**—Quality has been judged by the average maximum height of the trees at or approaching maturity. By this method, the forest has been divided into four quality classes, namely:—

First	..	Average maximum height of trees	..	50 feet and over.
Second	..	Ditto	..	35-50 feet.
Third	..	Ditto	..	20-35 feet.
Fourth	..	Ditto	..	under 20 feet.

This classification by height classes does not apply to *keora* (*Sonneratia apetala*), and *baen* (*Avicennia officinalis*), which grow much larger and taller than other Sundarbans trees. These two species are found mostly on the banks of *khals* and on new *chars*, where the soil conditions are different from those of contiguous areas; their quality, therefore, does not always correspond to that of the surrounding forest. In Chapter II of Part I, the forest has been divided up into three zones, namely, the fresh-water, the moderately salt, and the salt-water zones. Consequently, it has been found more satisfactory to classify the quality of *keora* and *baen* according to the zone in which they occur.

13. **Stock Maps.**—With the aid of the enumeration lines, and the personal reconnaissance of the officer in charge of the Working Plan Camp and his more senior subordinates, stock maps have been prepared for the whole division. The number of species liable to predominate in any particular area are very few, but the number of mixtures and qualities of forest in which they occur are very numerous. The stock maps have been printed in black and white; each species has a separate sign; the principal species, namely, *sundri*, *gengwa*, *passur* (*Carapa moluccensis*) and *dhundal* (*Carapa obovata*) are denoted by vertical, horizontal and slanting lines; the thickness of the line denotes the quality, and the distance apart denotes the proportion which the species forms in the crop. The key to the signs used will be found in Appendix II. For the better quality forests of the Khulna district, the stock maps have been made on a scale of 2 inches to the mile; for the poorer quality forests of the 24-Parganas district, maps on a scale of 1 inch to the mile were considered sufficient. Two

hundred copies each of these maps have been printed ; this number should be sufficient for the currency of this plan ; as a measure of economy, the plates have not been kept. Maps of each compartment on a 1 inch scale are shown in Appendix III.

14. **Compilation and results of the enumerations.**—The results of the linear enumerations for all the forests excepting the Namkhana Range are given in Appendix VI, and in more detail for each working circle, in Appendix IX ; sufficient detail has been given both in the plan and in the appendices, to enable the Divisional Officer to obtain a fairly reliable estimate of the stock of every important species. The results of the enumerations, line by line and compartment by compartment, and maps indicating the position of the enumerated lines have been bound in books, and placed in the library of the Divisional Office. For the purposes of this plan, the results of the enumerations were needed type by type, as well as compartment by compartment ; consequently, a fresh compilation was made, in which the enumerations in each compartment were divided up type by type ; these results, and their totals for the whole forest have also been bound in books, and placed in the divisional library. Many, and much more serious errors are likely to occur in compilation than in actual enumerations ; for this reason, the figures obtained type by type, were compared with the totals previously obtained for each compartment. Each total figure for each species was compared, and any differences of over 2 per cent. were traced and rectified. The lengths of the enumeration lines, and the lengths and widths of the *small khals* falling within them were recorded in separate books, and any errors were eliminated by a system of cross checking.

15. The average results of the linear enumeration for each quality of forest in the reserved areas, namely, in all ranges except Namkhana Range, are given on pages 77 and 78.

16. **Areas under each quality of forest.**—The following gives the area under each quality of forest according to the stock maps :—

Quality of Forest.	Reserved	Protected
	Forest.	Forest.
	Square	Square
	miles.	miles.
1st Quality .. ..	148·7	....
2nd Quality .. ..	544·3	....
3rd Quality .. ..	1,026·5	33·6
4th Quality .. ..	506·9	207·1
Blanks whose areas have been recorded ..	4·5	1·2
Total area of land ..	2,230·9	241·9

17-20 (revised). **Estimation of the volume of the growing stock.**—The average volume per acre of the growing stock in each working circle has been estimated with the aid of the volume tables in Appendix V. The minimum sizes used for the calculation of the volumes of timber and fuel in each species, are recorded beneath the tables. These minimum sizes are approximations of the minimum sizes at present utilised ; the tables, therefore, represent the ideal commercial volume, should every tree felled be fully utilised according to the present standards. Consequently, yields calculated with the aid of these tables, represent the possible commercial yields.

### Organisation into Ranges.

21-22 (revised). It will not be practicable to enforce the prescriptions made in this plan without decentralisation into forest ranges. (See paragraph 107 of Part I.) Accordingly, the forests have been divided up into six ranges, by using the principal river systems as the dividing boundaries. For convenience in administration, the  
(Continued on page 79.)



**AVERAGE ENUMERATION RESULTS FOR THE RESERVED FORESTS.**  
**First quality forest (average numbers of apparently sound trees per acre).**

Diameter class in inches.	Sundri.	Gengwa.	Passur.	Dhundal.	Kankra.	Amur.	Other kinds.	Diameter class in inches.	Keora.	Baen.
3-4	131.25	35.42	.79	.01	.40	6.25	7.88	3-6	.03	.27
4-5	91.54	22.47	.67	....	.32	1.44	3.17	6-9	.02	.27
5-6	66.69	15.37	.83	....	.23	.39	1.43	9-12	.01	.36
6-7	42.76	9.20	.44	....	.16	.16	.65	12-15	.05	.25
7-8	26.73	4.92	.32	....	.10	.04	.26	15-18	.03	.14
8-9	16.67	2.00	.26	....	.04	.03	.17	18-21	.02	.09
9-10	8.76	.94	.13	....	.02	.02	.10	21-24	.01	.05
10-11	5.40	.50	.09	....	.02	.01	.06	24-27	.01	.02
11-12	2.39	.18	.04	....	.02	.01	.04	27-30	.02	.02
12-13	1.28	.13	.04	....	....	....	.03	30, and over	.03	.05
13-14	.63	.05	.03	....	....	....	....			
14-15	.38	.02	....	....	....	....	....			
15-16	.21	.02	.01	....	....	....	.02			
16, and over	.31	.02	.02	....	....	....	.01			
Total	395.00	91.24	3.67	.01	1.29	8.34	13.83	Total	.23	1.52

**Second quality forest (average numbers of apparently sound trees per acre).**

Diameter class in inches.	Sundri.	Gengwa.	Passur.	Dhundal.	Kankra.	Amur.	Other kinds.	Diameter class in inches.	Keora.	Baen.
3-4	136.04	58.27	4.50	.16	5.14	6.15	8.72	3-6	.61	1.17
4-5	81.21	34.86	3.57	.12	3.34	1.34	2.92	6-9	.63	.68
5-6	48.36	20.42	2.97	.07	1.95	.37	1.13	9-12	.51	.58
6-7	26.18	9.67	2.24	.05	1.03	.10	.41	12-15	.30	.49
7-8	13.05	4.15	1.50	.02	.28	.03	.22	15-18	.14	.31
8-9	6.63	1.71	1.03	.02	.13	.01	.14	18-21	.06	.12
9-10	3.02	.67	.58	.01	.05	.01	.07	21-24	.02	.06
10-11	1.45	.28	.33	.01	.03	....	.05	24-27	.02	.03
11-12	.78	.11	.18	.01	.01	....	.04	27-30	.01	.02
12-13	.30	.05	.06	.00	.01	....	.03	30, and over	.01	.05
13-14	.16	.03	.05	.00	.01	....	.01			
14-15	.16	.01	.03	.01	.00	....	.01			
15-16	.08	.01	.01	....	.00	....	.01			
16, and over	.12	.01	.03	.01	.00	....	.02			
Total	317.54	130.25	17.08	.49	11.98	8.01	13.78	Total	2.31	3.51

Average enumeration results for the reserved forests—conclid.

**Third quality forest (average numbers of apparently sound trees per acre).**

Diameter class in inches.	Sundri.	Gengwa.	Passur.	Dhundal.	Kankra.	Amur.	White Baen.	Other kinds.	Diameter class in inches.	Keora.	Baen.
3-4	64.64	101.26	.88	.74	.76	1.19	.15	2.73	3-6	.31	.97
4-5	29.73	48.62	.82	.42	.44	.18	.09	.74	6-9	.40	.49
5-6	13.17	21.74	.66	.19	.28	.04	.04	.33	9-12	.37	.29
6-7	5.32	8.15	.53	.13	.14	.01	.02	.18	12-15	.28	.17
7-8	1.92	2.97	.39	.06	.08	.....	.00	.10	15-18	.18	.09
8-9	.72	1.18	.27	.06	.04	.....	.01	.06	18-21	.08	.03
9-10	.32	.46	.17	.04	.03	.....	.....	.03	21-24	.04	.01
10-11	.12	.19	.09	.04	.02	.....	.00	.02	24-27	.03	.01
11-12	.07	.08	.06	.03	.01	.....	.00	.01	27-30	.01	.00
12-13	.02	.03	.03	.02	.01	.....	.....	.01	30, and over	.01	.01
13-14	.01	.01	.02	.01	.00	.....	.....	.01			
14, and over	.03	.01	.03	.03	.02	.....	.....	.00			
Total	116.07	184.70	3.95	1.77	1.83	1.42	.31	4.22	Total	1.72	2.07

**Fourth quality forest (average numbers of apparently sound trees per acre).**

Diameter class in inches.	Sundri.	Gengwa.	Passur.	Dhundal.	Kankra.	Amur.	White Baen.	Other kinds.	Diameter class in inches.	Keora.	Baen.
3-4	2.01	50.11	.88	2.27	1.34	.04	1.25	4.02	3-6	.41	1.19
4-5	.65	17.47	.66	1.17	.62	.00	.47	1.85	6-9	.37	.42
5-6	.16	6.27	.51	.46	.32	.....	.19	1.08	9-12	.25	.17
6-7	.04	2.29	.39	.22	.17	.00	.08	.59	12-15	.11	.05
7-8	.02	.73	.23	.14	.08	.....	.02	.23	15-18	.08	.02
8-9	.01	.26	.16	.06	.03	.....	.02	.15	18-21	.02	.01
9-10	.01	.09	.06	.04	.01	.....	.00	.06	21-24	.01	.00
10-11	.....	.04	.04	.02	.02	.....	.01	.03	24-27	.01	.....
11-12	.....	.02	.02	.01	.01	.....	.01	.02	27-30	.00	.....
12-13	.....	.00	.02	.01	.00	.....	.....	.01	30, and over	.01	.....
13-14	.....	.....	.00	.01	.00	.....	.00	.....			
14, and over	.....	.....	.04	.02	.02	.....	.....	.01			
Total	2.90	77.28	3.01	4.43	2.62	.04	2.05	8.05	Total	1.27	1.86

NOTE.—The enumeration results for the Protected Forests, namely, Namkhana Range or Working Circle V, will be found in the part of Appendix IX which deals with that working circle.

continued from page 76—

ranges have been made to conform, as far as possible, with the civil subdivisions; but in the east, where the forests are of good quality and more intensive management is necessary, two ranges have been prescribed for the Bagerhat subdivision; and in the west, where the forest blocks are scattered and of poor quality, only one range has been considered necessary for the Diamond Harbour and Alipore subdivisions. The distribution and areas of the six range charges prescribed are as follows:—

#### KHULNA DISTRICT.

(i) *Sarankhola Range*.—In the Bagerhat civil subdivision, consisting of the reserved forests east of Arwaber *khal*, Sela *gang* and Bhangra river. The range contains Compartments Nos. 1, 2, 3, 4, 5, 6, 7, 11, 13, 24 and parts of Compartments 12 and 25. Area:—

	Acres.	Square miles.
Land .. .. .	177,917	278·0
Char .. .. .	10,296	16·1
Small <i>khals</i> and creeks .. .. .	5,654	8·8
Large <i>khals</i> , rivers and estuaries .. .. .	77,710	121·4
Total .. .. .	271,577	424·3

(ii) *Chandpai Range*.—This range consists of the reserved forests between the Arwaber *khal*, Sela *gang* and Bhangra river on the east, and the Passar and Murjattah rivers on the west; it contains Compartments Nos. 8, 9, 10, 14, 15, 21, 22, 23, 26, 27, 28, 45 and parts of Compartments Nos. 12 and 25. The range is situated in the Bagerhat subdivision, except for the part of Compartment 45 west of the Passar river, which is in the Sadar subdivision. Area:—

	Acres.	Square miles.
Land .. .. .	202,652	316·7
Char .. .. .	4,924	7·7
Small <i>khals</i> and creeks .. .. .	5,916	9·2
Large <i>khals</i> , rivers and estuaries .. .. .	75,654	118·2
Total .. .. .	289,146	451·8

(iii) *Khulna Range*.—In the Sadar subdivision, consisting of the reserved forests between the Passar and Murjattah rivers on the east, and the Arpangasia and Barapanga rivers on the west. The range contains Compartments Nos. 16 to 20, and 29 to 44 inclusive. Area:—

	Acres.	Square miles.
Land .. .. .	358,683	560·4
Char .. .. .	6,218	9·7
Small <i>khals</i> and creeks .. .. .	10,612	16·6
Large <i>khals</i> , rivers and estuaries .. .. .	136,572	213·4
Total .. .. .	512,085	800·1

(iv) *Satkhira Range*.—The reserved forests of the Satkhira subdivision, between the Arpangasia and Barapanga rivers on the east, and the Kalindri *gang*, Raimangal river, Buri *gang* and Harinbhanga river on the west. The range contains Compartments Nos. 46 to 55 inclusive. Area :—

	Acres.	Square miles.
Land .. .. .	273,817	427·8
<i>Char</i> .. .. .	10,591	16·6
Small <i>khals</i> and creeks .. .. .	10,557	16·5
Large <i>khals</i> , rivers and estuaries .. .. .	114,806	179·4
Total .. .. .	409,771	640·3

#### 24-PARGANAS DISTRICT.

(v) *Basirhat Range*.—The reserved forests of the Basirhat subdivision, between the Kalindri *gang*, Raimangal river, Buri *gang* and Harinbhanga river on the east, and the Bidya and Matla rivers on the west. The range contains Compartments Nos. 56 to 70 inclusive. Area :—

	Acres.	Square miles.
Land .. .. .	414,703	648·0
<i>Char</i> .. .. .	11,832	18·5
Small <i>khals</i> and creeks .. .. .	18,937	29·6
Large <i>khals</i> , rivers and estuaries .. .. .	193,246	301·9
Total .. .. .	638,718	998·0

The jurisdiction of this range also includes the leased lands, still containing forests, within the Basirhat subdivision.

(vi) *Namkhana Range*.—In the Alipore and Diamond Harbour subdivisions, between the Bidya and Matla rivers on the east, and the Muriganga or Channel Creek on the west ; it comprises the whole of the protected forests within the division. This range contains Compartments Nos. 71 to 75 inclusive. Area :—

	Acres.	Square miles.
Land .. .. .	154,809	241·9
<i>Char</i> .. .. .	35,778	55·9
Small <i>khals</i> and creeks .. .. .	5,822	9·1
Large <i>khals</i> , rivers and estuaries .. .. .	212,094	331·4
Total .. .. .	408,503	638·3

The jurisdiction of this range also includes the leased lands, still containing forests, within the Alipore and Diamond Harbour subdivisions.

### Working Circles.

23. Under the last working plan, the division was divided into two working circles, namely, the Eastern or *Sundri* Working Circle, and the Western Working Circle. For the more intensive exploitation prescribed in this plan, these two circles will not be sufficient. In order to confine the felling of all important species to coupes, to give them proper silvicultural treatment and to regulate their outturn, a more complete system of working circles is necessary.

24. In Part I, Chapter II, the forests have been divided up into three zones, namely: the fresh-water zone, which consists mainly of dense, well stocked forests of first and second quality; the moderately salt-water zone, which consists mostly of less densely stocked third quality forests; and the poorly stocked salt-water areas, which contain forests of either fourth quality, or poor third quality. In the first zone, *sundri* is the predominant tree; in the second, *gengwa* is numerically predominant, but the volume of *sundri* available for felling is equal to that of the *gengwa*; and in the salt-water forests, the exploitable trees are generally few, and widely spaced. Obviously, these zones will require different degrees of management and control; also, the most suitable felling cycle for each will vary. Accordingly, the first three working circles prescribed have been made to conform to these zones. One of the principal sources of revenue in the Sundarbans, is the sale of the small wood of *goran* (*Ceriops Roxburghiana*). This species has a much shorter rotation than the larger trees, and requires separate treatment and control. For this reason, it is convenient to form a secondary working circle for the *goran*, superimposed upon the first three working circles. West of the Bidya and Matla rivers, the forests, besides being of extremely poor quality, are protected only, and not reserved; consequently, less detailed management is required for these forests, and they have been constituted into a separate working circle.

25. The boundaries of the five working circles prescribed, are given in the  $\frac{1}{4}$  inch map of the Sundarbans prepared for this plan; and in further detail, on the  $\frac{1}{2}$  inch maps showing the coupes to be felled, and on the 2 inches stock maps. Their distribution and areas are as follows:—

I. *The Fresh-water Working Circle*.—This working circle consists of the fresh-water forests, which are situated roughly north and east of a diagonal line drawn from Cobadak Forest Station to the mouth of Katka *khal*. Area: 428,848 acres, or 670·1 square miles of land.

II. *The moderately Salt-water Working Circle*.—The moderately salt-water zone, which includes all forests west of Working Circle I and east of the Kalindri, Raimangal and Barapanga rivers, namely, the remainder of the forests within the Khulna district. Area: 584,221 acres, or 912·8 square miles of land.

III. *The Basirhat Working Circle*.—The eastern part of the salt-water zone, consisting of all forests within the Basirhat Range. Area: 414,703 acres, or 648·0 square miles of land.

IV. *The Goran Working Circle*.—This working circle is superimposed on Working Circles II and III, and the southern part of Working Circle I; it comprises all forests in the Basirhat and Satkhira Ranges, and all compartments in the Khulna, Chandpai and Sarankhola Ranges where the average stocking of *goran* sticks of over 1 inch diameter is not less than 100 per acre. Area: 1,210,025 acres, or 1,890·7 square miles of land.

V. *The Western Working Circle*.—The Protected Forests of the Namkhana Range, or the western part of the salt-water zone. Area: 154,809 acres, or 241·0 square miles of land.

### Felling Series.

26. About half the export of forest produce from the Sundarbans is made in small, locally owned boats of 400 maunds capacity and under. (*Vide* paragraph 76 of Part I.) Except in the calmest weather, these small boats cannot cross the larger rivers in a laden state; neither is it an economical proposition for the owners to travel long distances for the collection of their load. For the benefit of the trade with small boats and to avoid serious hardship and discontent, it is necessary, therefore, to provide coupes for each type of produce between each pair of main rivers. This necessitates the formation of a system of felling series, running north and south, in each working circle, with the main rivers as their dividing boundaries.

27. As the large rivers have been chosen as the boundaries of the range charges in a similar way to those of the felling series, a range boundary always coincides with one or more of the felling series boundaries. The larger ranges, from Khulna Range westwards, contain large intermediate, north and south rivers; for this reason two felling series have been prescribed for Working Circle I in Khulna Range, two each for Working Circles II and IV in Satkhira Range, and two each for Working Circles III and IV in Basirhat Range. Two felling series have been prescribed, also, for Working Circle V in Namkhana Range, but this division is for reasons which are explained in Chapter VI. On the other hand, there is very little forest in Sarankhola Range belonging to Working Circle II; consequently, in this working circle, one felling series has been considered sufficient for the Sarankhola and Chandpai Ranges. For similar reasons, one felling series each is considered enough for Working Circles II and IV in the Khulna Range, despite the division of the Sipsah River.

28. The distribution and areas of the felling series prescribed, are given in the following statement:—

Working Circle.	Felling Series.			
	No.	Name and distribution.	Area of land.	
			Acres.	Square miles.
I.—Fresh-water ..	1	<i>Sarankhola</i> .—All forests belonging to this circle in Sarankhola Range.	149,383	233·4
	2	<i>Chandpai</i> .—All forests belonging to this circle in Chandpai Range.	111,521	174·3
	3	<i>Passar</i> .—In Khulna Range, between the Passar and Sipsah rivers.	102,538	160·2
	4	<i>Sipsah</i> .—In Khulna Range, west of the Sipsah river.	65,406	102·2
II.—Moderately salt-water.	1	<i>Sela</i> .—All forests belonging to this circle in the Sarankhola and Chandpai Ranges.	119,665	187·0
	2	<i>Hansraj</i> .—All forests belonging to this circle in the Khulna Range.	190,739	298·0
	3	<i>Malancha</i> .—In Satkhira Range, east of the northern part of the Malancha river and the southern part of the Jamuna river.	126,775	198·1
	4	<i>Jamuna</i> .—In Satkhira Range, west of the northern part of the Malancha river and the southern part of the Jamuna river.	147,042	229·7

Working Circle.	Felling Series.			
	No.	Name and distribution.	Area of land.	
			Acres.	Square miles.
III.—Basirhat ..	1	<i>Harinbhanga</i> .—All forests in the Basirhat Range, east of the Jhilla and Goashaba rivers.	198,710	310·5
	2	<i>Haldi</i> .—All forests in the Basirhat Range, west of the Jhilla and Goashaba rivers.	215,993	337·5
IV.—Goran ..	1	The following compartments in Sarankhola Range: namely, Compartments Nos. 1 to 7 inclusive, 11, 13, and the part of Compartment 12 east of the Sela gang.	161,773	252·8
	2	The following compartments in Chandpai Range: namely, Compartments Nos. 8, 9, 10, 14, 15, 45, and the part of Compartment 12 west of the Sela gang.	135,179	211·2
	3	The following compartments in Khulna Range: namely, Compartments Nos. 16 to 20 inclusive, 38, 39, and 41 to 44 inclusive.	224,553	350·9
	4	All forests in the Satkhira Range, east of the northern part of the Malancha river and the southern part of the Jamuna river.	126,775	198·1
	5	All forests in Satkhira Range, west of the northern part of the Malancha river and the southern part of the Jamuna river.	147,042	229·7
↓ India ↓	6	All forests in Basirhat Range, east of the Jhilla and Goashaba rivers.	198,710	310·5
	7	All forests in Basirhat Range, west of the Jhilla and Goashaba rivers.	215,993	337·5
V.—Western ..	1	All forests in this circle east of the Thakuran river. Compartments Nos. 71 to 74 inclusive.	118,620	185·3
	2	All forests west of the Thakuran river. Compartment 75.	36,189	56·5

### Compartments.

29. The forty compartments, which comprised the Eastern Working Circle under the old plan, have been retained, in order that the record of their histories may be continued. The remaining forests have been divided up by suitable natural boundaries into thirty-five compartments of convenient size for ease in description. The descriptions were written as the field-work proceeded, and whilst the areas were still fresh in the mind of the officer in charge of the field survey; they will be found in Appendix III together with the histories of the fellings, etc., in each compartment, and their stock maps reduced to a scale of 1 inch to the mile.

### Summary of the Area Distribution.

30. The following statements summarise the division of the forests into ranges, working circles, felling series and compartments :—

#### Sarankhola Range.

Compartment No.	Working Circle I, Felling Series I.	Working Circle II, Felling Series I.	Total land area.	Char.	Small khals and creeks.	Total area of compartment.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
1 ..	25,095	..	25,095*	2,530	447	28,072
2 ..	13,318	..	13,318*	99	284	13,701
3 ..	13,853	..	13,853*	..	368	14,221
4 ..	15,268	..	15,268*	..	656	15,924
5 ..	12,352	..	12,352*	670	327	13,349
6 ..	17,659	257	17,916*	5,211	821	23,948
7 ..	2,086	25,787	27,873*	1,694	1,341	30,908
11 ..	11,052	2,490	13,542*	20	511	14,073
12 (eastern portion)	8,934	..	8,934*	..	216	9,150
13 ..	13,622	..	13,622*	..	243	13,865
24 ..	12,503	..	12,503	72	364	12,939
25 (eastern portion)	3,641	..	3,641	..	76	3,717
Total for the range	149,383	28,534	177,917	10,296	5,654	193,867

Area of large khals, rivers and estuaries, from the midstream of the Baleswar river to the midstreams of the Arwaber khal, Sela gang, and Bhangra river :—

77,710

Total area of range 424.3 square miles or ..

271,577

\*These areas are also included in Working Circle IV, Felling Series 1.

#### Chandpai Range.

Compartment No.	Working Circle I, Felling Series 2.	Working Circle II, Felling Series 1.	Total land area.	Char.	Small khals and creeks.	Total area of compartment.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
8 ..	..	32,728	32,728*	2,197	1,005	35,930
9 ..	2,368	29,568	31,936*	242	815	32,993
10 ..	13,197	1,599	14,796*	..	525	15,321
12 (western portion)	5,173	..	5,173*	32	196	5,401
14 ..	9,949	..	9,949*	..	258	10,207
15 ..	13,361	..	13,361*	..	457	13,818
21 ..	11,186	..	11,186	..	366	11,552
22 ..	11,306	..	11,306	..	237	11,543
23 ..	9,178	..	9,178	..	202	9,380
25 (western portion)	7,193	..	7,193	..	203	7,396
26 ..	9,094	..	9,094	..	398	9,492
27 ..	9,457	..	9,457	10	318	9,785
28 ..	10,059	..	10,059	..	215	10,274
45 ..	..	27,236	27,236*	2,443	721	30,400
Total for the range	111,521	91,131	202,652	4,924	5,916	213,492

Area of large khals, rivers and estuaries, from the midstreams of the Arwaber khal, Sela gang and Bhangra river, to the midstreams of the Passar and Murjattah rivers :—

75,654

Total area of range 451.8 square miles, or ..

289,146

\* These areas are also included in Working Circle IV, Felling Series 2.



## Khulna Range.

Compartment No.	Working Circle I.		Working Circle II. Felling Series 2.	Total land area.	Char.	Small khals and creeks.	Total area of compartment.
	Felling Series 3.	Felling Series 4.					
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
16	11,082	..	4,525	15,607*	35	364	16,006
17	..	..	20,200	20,200*	433	383	21,016
18	..	..	31,359	31,359*	795	870	33,024
19	..	..	19,729	19,729*	16	726	20,471
20	..	..	19,103	19,103*	69	662	19,834
29	10,941	..	..	10,941	288	221	11,450
30	12,104	..	..	12,104	..	344	12,448
31	15,531	..	..	15,531	..	427	15,958
32	12,630	..	..	12,630	..	508	13,138
33	12,036	..	..	12,036	21	364	12,421
34	12,715	..	..	12,715	..	441	13,156
35	..	16,415	..	16,415	36	373	16,824
36	..	17,687	..	17,687	..	634	18,321
37	..	11,751	2,369	14,120	..	410	14,530
38	..	9,602	6,755	16,357*	19	579	16,955
39	15,499	..	..	15,499*	..	412	15,911
40	..	9,951	..	9,951	187	313	10,451
41	..	..	18,246	18,246*	35	677	18,958
42	..	..	18,459	18,459*	47	594	19,100
43	..	..	25,074	25,074*	987	762	26,823
44	..	..	24,920	24,920*	3,250	548	28,718
Total for the range	102,538	65,406	190,739	358,683	6,218	10,612	375,513
Area of large khals, rivers and estuaries, from the midstreams of the Passar and Murjattah rivers to the midstreams of the Arpangasia and Barapanga rivers :—							136,572
Total area of range 800.1 square miles, or ..							512,085

\*These areas are also included in Working Circle IV, Felling Series 3.

## Satkhira Range.

Compartment No.	*Working Circle II.		Total land area.	Char.	Small khals and creeks.	Total area of compartment.
	Felling Series 3.	Felling Series 4.				
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
46	27,991	..	27,991	19	1,613	29,623
47	..	25,276	25,276	..	1,491	26,767
48	..	20,149	20,149	58	956	21,163
49	..	28,816	28,816	278	980	30,074
50	4,728	14,743	19,471	19	779	20,269
51	9,041	15,620	24,661	18	721	25,400
52	29,499	..	29,499	149	881	30,529
53	20,709	..	20,709	310	546	21,565
54	34,807	..	34,807	6,004	1,151	41,962
55	..	42,438	42,438	3,736	1,439	47,613
Total for the range	126,775	147,042	273,817	10,591	10,557	294,965
Area of large khals, rivers and estuaries, from the midstreams of the Arpangasia and Barapanga rivers to the midstreams of the Kalindri gang, Raimangal river, Buri gang and Harinbhanga river :—						114,806
Total area of range 640.3 square miles, or ..						409,771

\*Felling Series 3 of Working Circle II coincides with Felling Series 4 of Working Circle IV, and Felling Series 4 of Working Circle II coincides with Felling Series 5 of Working Circle IV.

## Basirhat Range.

Compartment No.	*Working Circle III.		Total land area.	Char.	Small khals and creeks.	Total area of compartment.
	Felling Series 1.	Felling Series 2.				
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
56 ..	23,879	..	23,879	152	1,244	25,275
57 ..	..	27,148	27,148	254	1,102	28,504
58 ..	27,642	..	27,642	1,273	1,176	30,091
59 ..	23,419	..	23,419	266	1,316	25,001
60 ..	26,467	..	26,467	8	1,579	28,054
61 ..	27,905	..	27,905	185	1,239	29,329
62 ..	30,913	..	30,913	2,602	842	34,357
63 ..	30,937	..	30,937	1,058	1,010	33,005
64 ..	..	32,118	32,118	3,857	847	36,822
65 ..	..	30,491	30,491	1,007	1,080	32,578
66 ..	7,548	18,456	26,004	338	1,598	27,940
67 ..	..	28,435	28,435	165	1,799	30,399
68 ..	..	26,435	26,435	276	778	27,489
69 ..	..	28,902	28,902	47	1,986	30,935
70 ..	..	24,008	24,008	344	1,341	25,693
Total for the range	198,710	215,993	414,703	11,832	18,937	445,472
Area of large khals, rivers and estuaries, from the midstreams of the Kalindri gang, Raimangal river, Buri gang and Harinbhanga river, to the midstreams of the Bidya and Matla rivers :—						193,246
Total area of range 998·0 square miles, or ..						638,718

\*Felling Series 1 of Working Circle III coincides with Felling Series 6 of Working Circle IV, and Felling Series 2 of Working Circle III coincides with Felling Series 7 of Working Circle IV.

## Namkhana Range.

Compartment No.	Working Circle V.		Total land area.	Char.	Small khals and creeks.	Total area of compartment.
	Felling Series 1.	Felling Series 2.				
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
71 ..	23,723	..	23,723	2,688	646	27,057
72 ..	33,891	..	33,891	2,743	1,619	38,253
73 ..	32,873	..	32,873	2,307	1,006	36,186
74 ..	28,133	..	28,133	1,986	1,515	31,634
75 ..	..	36,189	36,189	26,054	1,036	63,279
Total for the range	118,620	36,189	154,809	35,778	5,822	196,409
Area of large khals, rivers and estuaries, from the midstreams of the Bidya and Matla rivers to the western bank of the Muriganga or Channel Creek :—						212,094
Total area of range 638·3 square miles, or ..						408,503

### Exploitable Ages and Sizes.

31. As already mentioned, the major working circles are prescribed according to the zones described in Chapter II of Part I. These zones are by no means homogeneous. Working Circle I, besides containing first and second quality forests, includes a considerable area of third quality forest: similarly, in Working Circle II, there are considerable areas of second and fourth quality forests, although the working circle consists mainly of third quality forest; remarks of the same nature apply to Working Circles III and V. For this reason, it is more convenient to prescribe the exploitable sizes of the various qualities of all important species except *goran*. for the whole forests, and not for each particular working circle.

32. Most kinds of Sundarbans trees grow only to a small size, and for a small increase in the diameter of a tree, there is a considerable difference in the intrinsic value of the timber. When dealing with the timber yielding species, therefore, the most suitable exploitable diameters will be the ones which will yield the largest sized timber, without unduly lengthening the rotation and increasing the proportion of casualties on account of old age. The exploitable ages detailed in the following paragraphs have been chosen with this end in view.

33. **Sundri.**—First and second quality *sundri* are the only types of trees in the division about which we have reliable information regarding the rate of growth. Their diameter increment curves are given in Appendix IV. The curve for first quality *sundri* has been calculated from measurements taken from the present sample plots Nos. 1, 3, 3A, 5, 6 and 7, diameter increment plots Nos. 2 and 3, and the records of measurements of old sample plots Nos. I, VI, VII and VIII. The curve for second quality has been obtained from measurements taken from the present sample plot No. 9, and old sample plots Nos. II, III and IV. The methods used for calculating the curves are described in the appendix.

By combining these diameter increment curves with the volume table in Appendix V, it is found that the average single tree of first quality *sundri* attains its maximum average increment in timber volume of .138 cubic feet per year, between the ages of 141 and 148 years, or between 14 inches and 14.5 inches in diameter. Similarly, the average tree of second quality attains its maximum average timber increment of .061 cubic feet per year at the age of 147 years, when it reaches 11 inches diameter. Unfortunately, comparatively few trees appear to survive to these ages in their respective qualities; *sundri* appears to be liable to become unsound during the period of its most vigorous growth: this is evident from the proportion of unsound trees in the enumeration results, which is 16.5 per cent. for first quality *sundri* of 14 inches to 15 inches diameter, and 13.4 per cent. for second quality at 11 inches diameter. The average height of the first quality forest is probably between 55 feet and 60 feet; from personal experience, the average diameter up to which an average tree of this height growth remains sound and healthy, is estimated at 13 inches, corresponding to an age of 131.5 years. This diameter may be termed the mature diameter; trees beyond this size are very liable to develop cankers, or become stag-headed. Similarly, the corresponding mature diameter of average second quality *sundri* is estimated at somewhere near 10 inches.

34. As the forests will be worked under the selection system, with fairly long felling cycles, it is necessary to fix the exploitable diameters lower than the mature diameters, in order to save loss by over-mature trees becoming unsound. The average exploitable diameter for first quality *sundri* is prescribed, therefore, at 12 inches, corresponding to an age of 123.9 years; at this size, the enumeration results show 5.95 per cent. of unsound trees. Similarly, the average exploitable diameter of second quality *sundri* is fixed at 9 inches, which corresponds to an age of 115.9 years, and for which the enumeration results show 6.16 per cent. of unsound trees.

35. There are no data, at present, regarding the rate of growth of third and fourth quality *sundri*. The exploitable diameters for first and second quality, have been chosen where the percentage of unsound trees is about 6 per cent. The enumeration results for third quality show 5.84 per cent. unsound trees between 5 inches and 6 inches diameter, and 8.76 per cent. between 6 inches and 7 inches diameter; accordingly, 6 inches is prescribed as the average exploitable diameter for third quality *sundri*. The enumeration results for fourth quality show a high proportion of unsound trees for all sizes from 2 inches upwards; obviously, such dwarf trees are

growing in an environment that does not suit *sundri*, and casualties are inevitable. However, a considerable proportion of the trees are capable of attaining a diameter of 3 inches to 4 inches, and as trees below this size are not generally utilisable, the exploitable diameter of this quality has been made 3 inches. By comparison with the difference between the exploitable ages of first and second quality, the exploitable ages for third and fourth quality *sundri* are estimated at 108 and 100 years respectively.

36. **Gengwa, passur, dhundal, kankra and white baen.**—The exploitable diameters of these species have been estimated partly from personal knowledge of the forests, and partly from an examination of the proportion of unsound trees in the enumeration figures in the same way as for the *sundri*. In the case of *dhundal* and fourth quality *passur*, most of the apparently sound trees above 7 inches in diameter, were found to be hollow when felling sample trees for the volume tables in Appendix V; this information has also acted as a guide for choosing the most suitable size for felling. The exploitable diameters fixed on these lines are tabulated in paragraphs 38 and 39.

37. We have little knowledge regarding the rate of growth of species other than *sundri*. For the purpose of estimating the yields, the exploitable ages of the *Rhizophora*, *passur*, *dhundal* and *kankra*, which are hard heavy woods, have been assumed to be the same as those for *sundri* of similar exploitable diameters; the probability is that these species are of more rapid growth than *sundri*; consequently, the yields calculated with the use of these ages will not be over-estimated. *White baen* (*Avicennia alba*) is only a semi-hard wood; but on account of the apparent slow growth of *baen* (*Avicennia officinalis*) (vide paragraph 127 of Part I), its exploitable ages also have been estimated as similar to those of *sundri*. In paragraph 125 of Part I, it has been estimated that second quality *gengwa* attains a diameter of 10 inches in 100 years; the exploitable ages of this species for the four quality classes have been estimated on this standard.

38. **Table of exploitable diameters and ages.**—The following table gives the average exploitable diameters and ages, prescribed in each quality class for the six species which have been dealt with:—

Species.	First quality.		Second quality.		Third quality.		Fourth quality.	
	Exploit-able diameter.	Exploit-able age in years.	Exploit-able diameter.	Exploit-able age in years.	Exploit-able diameter.	Exploit-able age in years.	Exploit-able diameter.	Exploit-able age in years.
<i>Sundri</i> ..	<sup>or</sup> 30.4 12	124	<sup>or</sup> 22.8 9	116	<sup>or</sup> 15.2 6	108	<sup>or</sup> 7.6 3	100
<i>Gengwa</i>	30.4 12	105	25.4 10	100	17.7 7	93	10.1 4	86
<i>Passur</i> ..	30.4 12	124	30.4 12	124	22.8 9	116	15.2 6	108
<i>Dhundal</i>	15.2 6	108	15.2 6	108	15.2 6	108	12.7 5	105
<i>Kankra</i>	22.8 9	116	22.8 9	116	22.8 9	116	15.2 6	108
<i>White baen</i>	..	..	..	..	15.2 6	108	12.7 5	105

39. **Table of exploitable diameters to be used in the marking and felling rules.**—The quality classes are comparatively large divisions compared with the small size of the trees and the slow rate of growth; also, small differences in the exploitable diameters will have a considerable effect on the quantity and value of timber, which will be available from the fellings. For the purpose of the felling rules, therefore, the

actual exploitable diameters to be used are prescribed in sub-quality classes for each difference of 5 feet in height growth, in the following table:—

### Exploitable Diameters.

Quality.	Average maximum height of surrounding forest in feet.	Sundri.	Gengwa.	Passur.	Dhundal.	Kankra.	White baen.
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
First	65 and over	14	14	12	6	9	..
	60—64	13	13	12	6	9	..
	55—59	12	12	12	6	9	..
	50—54	11	11	12	6	9	..
Second	45—49	10	11	12	6	9	..
	40—44	9	10	12	6	9	..
	35—39	8	9	11	6	9	..
Third	30—34	7	8	10	6	9	6
	25—29	6	7	9	6	9	6
	20—24	5	6	8	6	8	6
Fourth	15—19	4	5	7	6	7	6
	10—14	3	4	6	5	6	5

40. **Exploitable diameters for keora and baen.**—The remaining two important timber yielding trees, for which it is necessary to fix the exploitable diameters and ages, are *keora* and *baen*. The quality of these species does not always vary with that of the surrounding forest; it is therefore more convenient to fix the exploitable diameters compartment by compartment. These sizes were estimated during the fieldwork for the plan.

### Exploitable Diameters for Keora and Baen.

Compartment No.	Keora.	Baen.	Compartment No.	Keora.	Baen.	Compartment No.	Keora.	Baen.
	Inches.	Inches.		Inches.	Inches.		Inches.	Inches.
1	26	24	26	28	25	51	18	16
2	25	23	27	28	25	52	20	18
3	23	21	28	28	25	53	18	16
4	22	20	29	28	26	54	18	16
5	20	18	30	28	26	55	18	14
6	20	18	31	28	25	56	18	16
7	22	20	32	26	24	57	16	14
8	23	20	33	26	24	58	15	13
9	22	20	34	25	23	59	16	14
10	22	20	35	25	23	60	14	13
11	22	20	36	25	22	61	15	12
12	23	21	37	26	23	62	16	13
13	24	22	38	26	23	63	16	13
14	26	25	39	25	23	64	14	13
15	23	21	40	25	22	65	14	13
16	25	23	41	25	22	66	14	13
17	26	23	42	24	19	67	14	12
18	25	20	43	25	18	68	13	12
19	26	22	44	24	22	69	13	12
20	26	22	45	25	20	70	14	12
21	25	23	46	23	21	71	12	10
22	27	25	47	20	18	72	11	10
23	27	25	48	20	17	73	10	10
24	27	25	49	18	16	74	9	9
25	28	25	50	22	20	75	9	10

NOTE.—The above exploitable diameters are for single stemmed trees only.

41. **Exploitable ages of keora.**—The only information regarding the rate of growth of *keora* is given in paragraph 126 of Part I. For the purpose of estimating the yield, the following ages, corresponding to the average exploitable diameters for each zone, have been assumed and should give conservative results :—

Type of area, or zone.	Average exploit- table diameter.	Average exploit- table age.
	Inches.	Years.
Fresh-water, or Working Circle I .. .. .	25	85
Moderately salt-water, or Working Circle II .. .. .	20	80
Salt-water, or Working Circles III and V .. .. .	15	75

42. **Exploitable ages of baen.**—The information given in paragraph 127 of Part I has been used as a basis for estimating the following exploitable ages :—

Type of area, or zone.	Average exploit- table diameter.	Average exploit- table age.
	Inches.	Years.
Fresh-water, or Working Circle I .. .. .	23	172
Moderately salt-water, or Working Circle II .. .. .	18	160
Salt-water, or Working Circles III and V .. .. .	13	148

#### The Period for which Prescriptions have been made.

43. It will be seen in Chapter II, that the felling cycle of by far the most valuable working circle, namely, Working Circle I, is 20 years. In this circle, therefore, this will be the most suitable period for the plan ; it is not advisable to prescribe operations for a longer period. It will be more economical and convenient if all the working circles in the division are revised at the same time ; accordingly, prescriptions for the next 20 years have been made for all fellings and the collection of minor produce throughout the division.

44. Little is known regarding the rate of growth of several important species : notably, *gengwa*, *goran*, *passur*, *baen* and *keora*. In ten years' time, it is expected that there will be fairly reliable data regarding most of these trees. Consequently, the plan should be examined after a period of 10 years. If the estimated rates of growth used show large errors, necessary modifications in the prescriptions should be made, but no fresh enumeration or extensive field-work will be necessary. The *Goran* Working Circle has been given a short felling cycle of 16 years ; it is expected that we shall get reliable information regarding the rate of growth of *goran* after about 5 years. The prescriptions for this species, therefore, should be examined after this period, and modified if necessary.

## CHAPTER II.

## THE SCHEME FOR WORKING CIRCLE I OR THE FRESH-WATER WORKING CIRCLE.

## The General Composition and Analysis of the Crop.

45. **The composition of the crop.**—This working circle consists of the forests in the fresh-water zone. The crop and character of the vegetation of this zone have been described in paragraphs 39 to 41 inclusive of Part I. As far as possible, the circle has been made to contain all the first and second quality forests; it is, therefore, the most valuable working circle in the division. The crop consists mainly of *sundri* mixed with variable proportions of *gengwa* and other species. *Passur* and *kankra* will form a valuable addition to the yield, particularly in the northern parts of Felling Series 3 and 4. *Keora*, *baen* and *amur* are other valuable species, which are common throughout the circle. The following statement gives the composition of the crop according to the stock maps :—

Type of forest.	Felling Series 1.	Felling Series 2.	Felling Series 3.	Felling Series 4.	Total.
	Acres.	Acres.	Acres.	Acres.	Acres.
<b>First quality (over 50 feet height growth)—</b>					
<i>Sundri</i> pure (over 90 per cent. of crop) ..	..	1,117	4,017	..	5,134
<i>Sundri</i> (66½ to 95 per cent.), and <i>gengwa</i> (5 to 33½ per cent.)	44,393	39,499	6,112	..	90,004
Total first quality forest ..	44,393	40,616	10,129	..	95,138
<b>Second quality (35 feet to 50 feet height growth)—</b>					
<i>Sundri</i> pure (over 90 per cent. of crop) ..	..	..	18,760	26,824	45,584
<i>Sundri</i> (66½ to 95 per cent.), mixed with—					
<i>Gengwa</i> (5 to 33½ per cent.) ..	1,553	36,795	35,249	10,390	83,987
<i>Gengwa</i> (5 to 33½ per cent.), with understory of <i>goran</i> .	13,526	13,157	..	..	26,683
<i>Gengwa</i> , <i>passur</i> , and <i>kankra</i> (5 to 33½ per cent.).	..	291	5,367	..	5,658
<i>Sundri</i> (33½ to 66½ per cent.), mixed with—					
<i>Gengwa</i> (33½ to 66½ per cent.) ..	160	497	566	..	1,223
<i>Gengwa</i> (33½ to 66½ per cent.) with understory of <i>goran</i> .	72,980	7,510	..	..	80,490
<i>Gengwa</i> (5 to 33½ per cent.), <i>passur</i> (5 to 33½ per cent.) and <i>kankra</i> (5 to 33½ per cent.)	..	..	7,899	..	7,899
<i>Passur</i> (33½ to 66½ per cent) ..	..	..	11,013	25,173	36,186
<i>Passur</i> (33½ to 66½ per cent.), and <i>kankra</i> (5 to 33½ per cent.).	..	..	5,980	..	5,980
Carried forward ..	88,219	58,250	84,834	62,387	293,690

Type of forest.	Felling Series I.	Felling Series 2.	Felling Series 3.	Felling Series 4.	Total.
<b>Second quality (35 feet to 50 feet height growth)—concluded.</b>	Acres.	Acres.	Acres.	Acres.	Acres.
Brought forward ..	88,219	58,250	84,834	62,387	293,690
<i>Sundri</i> (5 to 33½ per cent.), mixed with—					
<i>Gengwa</i> (66⅔ to 95 per cent.) with understory of <i>goran</i> .	1,077	..	..	..	1,077
<i>Passur</i> (5 to 33½ per cent.), and <i>kankra</i> (5 to 33½ per cent.)	..	..	..	886	886
Forests with less than 5 per cent. of <i>sundri</i> —					
<i>Gengwa</i> pure (over 90 per cent. of crop)	..	65	144	..	209
<i>Passur</i> (33½ to 66⅔ per cent.) and <i>kankra</i> (33½ to 66⅔ per cent.)	..	..	..	487	487
<i>Kankra</i> pure (over 90 per cent. of crop)	..	..	..	118	118
<i>Keora</i> * .. .. .	2,546	95	..	..	2,641
<i>Keora</i> (66⅔ to 95 per cent.) and <i>baen</i> (5 to 33½ per cent.)	1,275	..	..	..	1,275
Total second quality forest ..	93,117	58,410	84,978	63,878	300,383
<b>Third quality (20 feet to 35 feet height growth)—</b>					
<i>Sundri</i> pure (over 90 per cent. of crop) ..	..	..	3,623	..	3,623
<i>Sundri</i> (66⅔ to 95 per cent.) and <i>gengwa</i> (5 to 33½ per cent.)	..	..	3,509	1,528	5,037
<i>Sundri</i> (33½ to 66⅔ per cent.) and <i>gengwa</i> (33½ to 66⅔ per cent.)	..	3,225	299	..	3,524
<i>Sundri</i> (33½ to 66⅔ per cent.) and <i>gengwa</i> (33½ to 66⅔ per cent.), with understory of <i>goran</i> .	3,637	7,602	..	..	11,239
<i>Sundri</i> (5 to 33½ per cent.) and <i>gengwa</i> (66⅔ to 95 per cent.)	..	281	..	..	281
<i>Sundri</i> (5 to 33½ per cent.), and <i>gengwa</i> (66⅔ to 95 per cent.) with understory of <i>goran</i> .	6,949	603	..	..	7,552
<i>Gengwa</i> pure (over 90 per cent. of crop)	..	328	..	..	328
<i>Gengwa</i> pure with understory of <i>goran</i>	12	456	..	..	468
Total third quality forest ..	10,598	12,495	7,431	1,528	32,052
<b>Maidan</b> .. .. .	1,275	..	..	..	1,275
Total area ..	149,383	111,521	102,538	65,406	428,848

\* *Keora* forest can seldom be called pure; it generally contains an understory of young *sundri* or *gengwa* poles.

46. **Volume of the growing stock.**—The working circle contains three qualities of forest, namely, first, second and third. The enumeration results of the apparently sound trees in these three qualities within the working circle are given in Appendix IX. These enumerations have been converted into volumes with the aid of the volume tables and into volumes per acre, by proportion with the length of the enumeration lines; the results are given in the succeeding three pages.



## First quality forest (volumes of apparently sound trees per acre).

Diameter class.	Sundri.		Gengua.		Passur.		Dhundala		*Other kinds.	
	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.
Inches.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
3-4	118.13	52.50	70.83	.71	.43	.01	.00	3.45	5.99	
4-5	146.47	43.94	22.47	1.20	.27	....	....	2.72	2.47	
5-6	165.38	44.01	15.37	1.75	.50	....	....	1.83	1.21	
Total 3 inches to 6 inches	429.98	140.45	108.67	3.66	1.20	.01	.00	8.00	9.67	
6-7	158.19	34.20	11.96	1.29	.40	....	....	1.27	.81	
7-8	136.33	26.73	7.87	1.25	.42	....	....	.71	.39	
8-9	110.03	20.00	3.80	1.32	.50	....	....	.50	.32	
9-10	71.81	12.26	2.17	.88	.32	....	....	.46	.35	
10-11	54.58	9.19	1.36	.75	.28	....	....	.32	.19	
11-12	30.53	5.25	.61	.47	.17	....	....	.10	.10	
12-13	20.26	4.62	.52	.55	.23	....	....	.07	.07	
13-14	11.66	3.87	.21	.43	.21	....	....	.05	.05	
14-15	7.74	3.72	.11	....	....	....	....	.02	.02	
15-16	4.55	2.89	.09	.10	.06	....	....	.02	.02	
16 and over	7.26	6.77	.19	.54	.38	....	....	....	....	
Total over 6 inches	612.94	129.50	28.89	7.58	2.97	....	....	3.52	2.32	
Grand total	1,042.92	269.95	137.56	11.24	4.17	.01	.00	11.52	11.99	

\* Does not include the volumes of keora, baen, goran, singra and khalshi.

## Second quality forest (volumes of apparently sound trees per acre).

Diameter class. Inches.	Sundri.		Gengwa.		Passur.		Dhunda.		*Other kinds.	
	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
3-4	111.56	55.78	....	90.50	4.45	2.72	.05	.03	8.05	9.67
4-5	132.35	42.69	58.37	29.19	6.99	1.55	.08	.01	7.97	4.27
5-6	120.22	36.59	52.16	15.45	6.80	1.95	.07	.02	6.29	2.52
Total 3 inches to 6 inches	364.13	135.06	110.53	135.14	18.24	6.22	.20	.06	22.31	16.46
6-7	95.03	28.80	31.32	7.59	7.12	2.21	.05	.03	4.39	1.67
7-8	63.83	18.86	15.54	3.68	6.35	2.12	.02	.03	1.74	.72
8-9	40.56	11.80	7.56	1.68	5.47	2.08	.01	.02	1.12	.53
9-10	22.87	6.48	3.53	.87	4.03	1.49	.01	.03	.59	.31
10-11	13.32	3.62	1.71	.50	2.98	1.10	.01	.03	.44	.26
11-12	8.76	2.23	.86	.33	2.34	.84	....	.01	.28	.19
12-13	3.99	1.06	.51	.21	1.05	.44	....	.02	.18	.14
13-14	2.39	.80	.34	.14	.98	48	....	....	.12	.06
14 and over	5.79	3.99	.32	.15	1.65	1.02	....	.02	.25	.22
Total over 6 inches	256.54	77.64	61.69	15.15	31.97	11.78	.10	.19	9.11	4.10
Grand total	620.67	212.70	172.22	150.29	50.21	18.00	.30	.25	31.42	20.56

Third quality forest (volumes of apparently sound trees per acre).

3-4	..	66.83	64.21	...	104.59	.56	.20	.05	.03	2.03	3.18
4-5	..	89.15	37.57	58.77	35.26	.82	.19	.13	.02	1.46	1.14
5-6	..	86.24	27.61	49.49	18.56	.83	.25	.06	.02	.86	.58
Total 3 inches to 6 inches	..	242.22	129.39	108.26	158.41	2.21	.64	.24	.07	4.35	4.90
6-7	..	65.26	19.12	31.35	9.54	1.16	.42	....	....	.36	.25
7-8	..	39.65	11.80	16.11	4.45	1.54	.61	....	....	.18	.15
8-9	..	21.56	6.51	7.05	1.96	.99	.41	....	....	.26	.19
9-10	..	12.26	4.99	3.98	1.26	1.24	.50	.02	.05	.06	.05
10-11	..	6.02	3.02	1.99	.71	.96	.39	.01	.07	.27	.21
11-12	..	3.17	1.77	.38	.19	.14	.06	....	....	.07	.07
12 and over	..	4.34	2.71	1.28	.69	1.78	1.19	....	....	.60	.60
Total over 6 inches	..	152.26	49.92	62.14	18.80	7.81	3.58	.03	.12	1.80	1.52
Grand total	..	394.48	179.31	170.40	177.21	10.02	4.22	.27	.19	6.15	6.42

NOTE.—The third quality forest in this working circle is of much better quality than the average for this quality class. The enumeration figures have been classified according to the stock maps, the boundaries between the qualities are not at all distinct in the forest, and many patches of second quality forest, too small to stock map, have been included in these enumeration figures. The average height of the forest stock mapped as third quality in this working circle, is estimated at well over 30 feet. For these reasons, the volumes of *sundri*, *gengua* and *passur* in the above table, have been calculated at a higher rate than the average third quality forest of the division; the special volume table used is given in Appendix IX. The volumes of the other species have not been revised, because their exploitable diameters and rotations do not differ so much between the third and second quality classes.

\* Does not include the volumes of *keora*, *baen*, *goran*, *singra* and *khalshi*.

47. In addition to the volumes given in the preceding statements, the following are the average volumes of sound *keora* and *baen* per acre throughout the working circle:—

			Timber.	Fuel.
			C. ft.	C. ft.
<i>Keora</i>	..	..	16.97	9.40
<i>Baen</i>	..	..	21.46	17.95

(See details of enumerations and calculations in Appendix IX.)

As explained in paragraph 40 of Chapter I, the quality of these two species does not vary so much with the quality of the surrounding forest, but depends mainly on the zone in which found.

48. As indicated in paragraph 10, the species utilised in small sizes were enumerated in 11 foot squares at every 5 chains. The enumeration results for *amur* on this system may be found in Appendix IX. Compartments Nos. 21 to 37 inclusive and Compartment No. 40, have been excluded from the *Goran* Working Circle; consequently the enumeration results for *goran*, *singra* and *khalshi* in these compartments will also be found in Appendix IX under the enumerations for this working circle. Estimates of the average volumes per acre of these small species have been made, and are given in that appendix.

49. **The condition of the crop and the distribution of the age classes.**—The enumerations show that mature sizes of most species are in deficit, and that there is an excess of pole growth. Regeneration is satisfactory throughout the working circle: below the minimum enumerated size (namely, below 3 inches in diameter), sapling and seedling growth was noticed to be particularly well represented. It is only the older age classes that need examination. With the aid of the diameter increment curves for first and second quality *sundri* given in Appendix IV, it is possible to compare the volume of the growing stock in each age class for this type of tree. On the assumption that the shapes of their diameter increment curves are similar to either that of first quality or that of second quality *sundri*, comparisons have also been made of the stocking of the age classes in third quality *sundri*, the three qualities of *gengwa*, and first and second quality *passur*.

50. **Sundri.**—

Age class.	Age period.	Corresponding diameter class.	Volume of timber and fuel per acre.
	Years.	Inches.	C. ft.
<b>First quality</b> (rotation = 134* years).			
III	.. 45 to 67	3.2 to 5.1	348
IV	.. 67 „ 89	5.1 „ 7.5	462
V	.. 89 „ 112	7.5 „ 10.3	315
VI	.. 112 and over	10.3 and over	154
<b>Second quality</b> (rotation = 126* years).			
III	.. 42 to 63	2.9 to 4.5	272
IV	.. 63 „ 84	4.5 „ 6.2	269
V	.. 84 „ 105	6.2 „ 8.0	182
VI	.. 105 and over	8.0 and over	128
<b>Third quality</b> (rotation = 121* years).			
III	.. (not enumerated.)		
IV	.. 60 to 80	3.5 to 4.8	167
V	.. 80 „ 101	4.8 „ 6.25	160
VI	.. 101 and over	6.25 and over.	181

\*In order to divide up the stock into age classes, it has been necessary to fix the rotations; the method used for estimating the rotations for each quality of each species, is explained in paragraph 57.

The ideal distribution of age classes for a *sundri* selection forest is not known; when young, its natural tendency is to grow in a very thick stand. However, except in the third quality forest, there is no doubt that the oldest age class is still considerably short of its normal figure and that poles and saplings are much in excess. The latter is the natural result of the lack of demand for fuel from the subsidiary thinnings during the currency of the last plan.

51. *Gengwa*.—

Age class.	Age period.	Corresponding diameter class.	Volume of timber and fuel per acre.
	Years.	Inches.	C. ft.
<b>First quality</b> (rotation = 115* years).			
III ..	38 to 57	3.25 to 5.2	134
IV ..	57 „ 76	5.2 „ 7.6	108
V ..	76 „ 95	7.6 „ 10.5	36
VI ..	95 and over	10.5 and over	10
<b>Second quality</b> (rotation = 110* years).			
III ..	37 to 55	3.1 to 4.8	152
IV ..	55 „ 73	4.8 „ 6.75	114
V ..	73 „ 92	6.75 „ 8.9	37
VI ..	92 and over.	8.9 and over.	10
<b>Third quality</b> (rotation = 105* years).			
III ..	35 to 53	2.7 to 4.1	145
IV ..	53 „ 70	4.1 „ 5.6	126
V ..	70 „ 88	5.6 „ 7.25	73
VI ..	88 and over.	7.25 and over.	35

The shortage in the last two age classes of this species is apparent. *Gengwa* is a light-demander compared with the shade bearing *sundri*; consequently the shortage of the older trees is further accentuated by the fact that the advance pole and sapling growth of this species beneath the standing crop is not so thick.

52. *Passur*.—The quality of this species varies little throughout the forests classified as first and second quality. The figures for these two qualities have therefore been combined :—

Age class.	First and second quality (rotation = 134* years).		
	Age period.	Corresponding diameter class.	Average volume of timber and fuel per acre.
	Years.	Inches.	C. ft.
III ..	45 to 67	3.2 to 5.1	12
IV ..	67 „ 89	5.1 „ 7.5	17
V ..	89 „ 112	7.5 „ 10.3	15
VI ..	112 and over.	10.3 and over.	10

\*In order to divide up the stock into age classes, it has been necessary to fix the rotations; the method used for estimating the rotations for each quality of each species, is explained in paragraph 57.

*Passur* (concluded) :—

It is evident from the foregoing figures that the age distribution of this species is somewhat better than that of *sundri*. *Passur* is a fairly heavy shade bearer; the younger age classes therefore cannot be considered much in excess. As with the *sundri*, there is still a deficit in the oldest age class. In the third quality forest, too few *passur* trees were enumerated to give a reliable average distribution. From an examination of the average volumes per acre of third quality *passur* in paragraph 46, it would appear that there is an excess of the oldest age class. This is due to the fact that the exploitable girth used during the currency of the former plan was 1 foot, irrespective of the quality of the forest; consequently, the mature sizes in the third quality forest have been left unexploited.

53. **Other species.**—The next tree in importance in the working circle is *baen*. This species has been very seriously overcut; sound mature trees are comparatively rare. During the currency of the former plan, the felling of *baen* was not regulated. Under this mode of treatment, the custom of many woodcutters was to lop branches of large trees for fuel or for small logs, with the result that most trees of any size are either unsound or absolutely hollow. The state of the *keora* crop is much more satisfactory. Owing to under-felling during the last 25 years, a certain proportion of overmature trees have become unsound, but there is a fairly large supply of sound mature *keora* which will compensate for the shortage of *baen*. The two most important small species to be worked under the prescriptions of this circle, are *amur* and *singra*. The felling of *amur* was regulated under the former system of management and its stocking is satisfactory; on the other hand, the felling of *singra* was not regulated, and as a consequence, this species has been badly over-felled. It should be noted that *singra* will be worked under the prescriptions for this working circle only in certain compartments [see Felling Rule (10) in paragraph 67].

#### Method of Treatment.

54. **The silvicultural system.**—In the last plan most of this working circle was included in that part of the old Eastern Working Circle, in which the *sundri* was worked under what amounted to improvement fellings combined with thinnings on a felling cycle of 20 years. (See paragraph 103, Part I.). *Sundri* being a fairly heavy shade-bearer, regeneration has been satisfactory under this system; without having experimented with any sort of regular method, it would be unsound to prescribe any system other than selection. The main disadvantage of a regular system is that *sundri* seedlings will not establish themselves readily, except under fairly heavy shade; if exposed, they dry off during the hot weather when the rivers are low and only a small portion of the forest is covered at high tide. Under this system, it would also be difficult to protect against wind damage, and the ingress of weeds such as *Pandanus*, fern and *Hibiscus*, which are very liable to invade cleared areas. The selection system, therefore, has been retained; but the time has come to make the prescriptions more definite; exploitable diameters have been fixed; and, although the fellings have been prescribed by area, a volume check has been added. The forests still contain many defective trees, and the proportion of the older age classes is still deficient; consequently, the fellings will continue to be of an improving nature. The system introduced may be termed "Selection cum Improvement Fellings."

55. This system has been extended to all important species, whereas before, regulations were prescribed only for *sundri*. The importance of these other species has already been pointed out in paragraph 5 of Chapter I; they require silvicultural treatment just as much as *sundri*. Under the former method of one coupe only for *sundri*, the exploitation of *passur*, *keora* and *kankra*, which was confined to this coupe, was neglected. With the four felling series now prescribed, it will be possible to utilise these species more fully; they are expected to yield a considerable amount of mature timber. With regard to other species, such as *genwa* and *baen*, owing to the disastrous results of unregulated cutting during the currency of the last plan, their fellings will be more of the nature of improvements and thinnings of the younger age classes than selection.

56. **The felling cycle.**—The former felling cycle of 20 years has been retained. This period has been fixed to suit the needs of first and second quality *sundri*, which are the principal types of tree in this working circle. The average exploitable diameters of these two types of tree are 12 inches and 9 inches respectively; during a period of

20 years, the average first quality *sundri* tree grows from 7·9 inches to 12 inches in diameter, and that of second quality grows from 7·2 inches to 9 inches in diameter. (Vide the diameter increment curves in Appendix IV.) In the first quality forest, the enumerations show that there is an average per acre of 33·2 *sundri* trees between 8 inches and 12 inches diameter, and only 2·8 stems per acre which have reached, or exceeded the exploitable diameter of 12 inches; in the second quality forest, similar averages show 21·9 trees between 7 inches and 9 inches in diameter, and 6·9 stems of and above the exploitable size. During the next 20 years, therefore, there is no doubt that there will be a gradual increase in the number of trees available on each succeeding coupe, which will have reached the exploitable sizes, and which will be available for selection. Under the prescription of 3 feet exploitable girth, fixed by the former plan for *sundri* of all qualities, many over-mature trees have been left in the second quality forest, very often at the expense of trees approaching the present exploitable sizes, which have been thinned in order to give these over-mature trees space. In the second quality forest, therefore, the increase will not be so marked. But, from an examination of the figures for the distribution of the age classes in paragraph 50, it is evident that, even after allowing for thinnings and casualties during the 20 years of this plan, the number of large sized trees per acre will continue to improve after this 20-year period is over, and that during the second felling cycle under this management the *sundri* crop should attain a normal distribution of age gradations for a selection forest. With regard to the needs of other species, *gengwa* is the only one which is found growing gregariously to any extent, and for which the length of the felling cycle is important. This species, although of quicker growth than the *sundri*, has been much overcut; consequently, the fellings will be comparatively light during the first felling cycle. If this management is continued over a second cycle, *gengwa* will be able to stand the comparatively heavy fellings expected, because its seedlings do not require the same amount of shade as those of *sundri*.

57. **The rotations.**—The exploitable diameter of first quality *sundri* has been fixed at 12 inches, corresponding to an age of 123·9 years. With a felling cycle of 20 years, the average age of mature trees exploited will be 133·9 years, corresponding to a diameter of 13·3 inches; in other words, the average rotation for first quality *sundri* will be 134 years. Similarly, the rotations for other qualities and species in this working circle will be 10 years more than the exploitable age. It has been pointed out in the foot-note to the statements of average volumes per acre in paragraph 46, that the third quality *sundri*, *gengwa* and *passur* in this working circle is of much better quality than the average of this quality class. For this reason, the average exploitable diameter of third quality *sundri* in this circle has been fixed at 7 inches, corresponding to an age of 110·6 years, that of third quality *gengwa* at 8 inches, corresponding to an age of 95·5 years, and that of third quality *passur* at 10 inches, corresponding to an age of 118·6 years. The average rotations for the three principal species, in each quality class, are therefore as follows:—

		Rotations in years.		
		<i>Sundri.</i>	<i>Gengwa.</i>	<i>Passur.</i>
First quality ..	..	134	115	134
Second quality..	..	126	110	134
Third quality ..	..	121	105	129

58. **Calculation of the yield for *sundri*.**—In previous paragraphs, it has been pointed out that the younger age classes of *sundri* are very much in excess, and that the demand for small poles and fuel is not nearly equal to the supply; consequently, it is not necessary to regulate the volume of the yield from the smaller sizes and fuel. Furthermore it would be difficult and expensive to control the felling of the small stuff, owing to the necessity of enumerating and recording the diameter and quality of each tree felled. It is proposed, therefore, to calculate the yield, and to equalise the outturn of timber, only from the trees of 6 inches diameter and over: it is the trees of this class, which yield the bulk of the revenue on the *sundri*, and for which there is the most demand.

59. The yield has been calculated by Hufnagel's method, based on the formula :—

$$Y = \frac{V_p + \frac{1}{2}p I}{p}$$

where, Y = the possible yield,  $V_p$  = the volume of the timber in the oldest age class of "p" period of years, and I represents the current annual increment of the age class.

This formula can be written  $Y = \frac{V_p}{p} + \frac{I}{2}$ . In this case, the yield from stems of

6 inches in diameter and over is needed; consequently, "p" has been taken as the difference between the rotation and the age of the average tree of 6 inches in diameter, and  $V_p$  has been taken as the volume in trees of 6 inches in diameter and over. The volumes per acre in each quality of forest have been calculated from the sound trees only; likewise, the control will be for sound trees only; but in order to allow for subsequent casualties amongst the sound trees, 25 per cent. has been deducted from the yield as calculated by the formula. Owing to the excess of the smaller sizes, both the volume and increment of trees passing the 6 inches diameter bar during the felling cycle will be greater each year; it is clear, therefore, that the method of calculation chosen will be safe from all possibility of an over-estimate.

60. The following gives the calculation of the yield of timber per average acre from apparently sound trees of 6 inches diameter and over, for each of the three qualities of forest :—

### First quality Sundri.

Calculation of I, the current annual increment for the average acre :—

Diameter class.	Period taken to grow through the diameter class.	Increment of timber of the average tree during growth through the diameter class. (Taken from the volume table curve.)			Current annual increment for the average tree.	Timber volume of the average tree (vide Appendix V).	Volume of sound timber in the average acre. (Vide paragraph 46).	Current annual increment of timber in the average acre.
		C. ft.	C. ft.	C. ft.				
Inches.	Years.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	
6 to 7	9.5	3.0	to 4.4	= 1.4	.1474	3.7	158.19	6.301
7 „ 8	9.0	4.4	„ 5.9	= 1.5	.1667	5.1	136.33	4.455
8 „ 9	8.2	5.9	„ 7.4	= 1.5	.1829	6.6	110.03	3.050
9 „ 10	7.5	7.4	„ 9.1	= 1.7	.2267	8.2	71.81	2.107
10 „ 11	7.1	9.1	„ 11.4	= 2.3	.3239	10.1	54.58	1.750
11 „ 12	7.1	11.4	„ 14.2	= 2.8	.3944	12.8	30.53	.941
12 „ 13	7.6	14.2	„ 17.1	= 2.9	.3816	15.8	20.26	.489
13 „ 14	9.9	17.1	„ 19.5	= 2.4	.2424	18.4	11.66	.154
14 „ 15	16.4	19.5	„ 21.1	= 1.6	.0976	20.4	7.74	.037
15 „ 16	32.2	21.1	„ 22.2	= 1.1	.0342	21.7	4.55	.007
16 and over.	Annual increment negligible.				..	..	7.26	..
Total ..						612.94	19.291	

Calculation of the possible annual yield for the average acre :—

$V_p = 612.94$ ,  $I = 19.291$  c. ft. Rotation = 133.9 years, average age of a tree of 6 inches diameter = 75.5 years; therefore  $p = 58.4$  years. Consequently, the yield of sound trees per acre =  $\frac{612.94}{58.4} + \frac{19.291}{2} = 20.141$  c. ft.; less 25 per cent. for casualties, it equals 15.11 c. ft. of timber per annum.



### Second quality Sundri.

Calculation of I, the current annual increment for the average acre :—

Diameter class.	Period taken to grow through the diameter class.	Increment of timber of the average tree during growth through the diameter class. (Taken from the volume table curve.)			Current annual increment for the average tree.	Timber volume of the average tree (vide Appendix V).	Volume of sound timber in the average acre. (Vide paragraph 46).	Current annual increment of timber in the average acre.
Inches.	Years.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
6 to 7	11.8	2.8	to	3.9 = 1.1	.0932	3.3	95.03	2.684
7 „ 8	11.1	3.9	„	4.9 = 1.0	.0901	4.4	63.83	1.307
8 „ 9	10.9	4.9	„	6.1 = 1.2	.1101	5.5	40.56	.812
9 „ 10	12.3	6.1	„	7.4 = 1.3	.1057	6.7	22.87	.361
10 „ 11	18.4	7.4	„	8.9 = 1.5	.0815	8.1	13.32	.134
11 „ 12	41.4	8.9	„	10.7 = 1.8	.0435	9.8	8.76	.039
12 „ 13	87.0	10.7	„	12.7 = 2.0	.0230	11.7	3.99	.008
13 „ 14	..*	12.7	„	13.8 = 1.1	..*	13.2	2.39	..*
14 and over.	..*	13.8	„	14.0 = .2	..*	14.0	5.79	..*
Total ..							256.54	5.345

\*Period taken to grow 1 inch in diameter is very long; the current annual increment per acre is, therefore, negligible.

Calculation of the possible annual yield for the average acre :—

$V_p = 256.54$ ,  $I = 5.345$  c. ft. Rotation = 125.9 years, average age of a tree of 6 inches diameter = 82.8 years; therefore,  $p = 43.1$  years. Consequently, the yield of sound trees per acre =  $\frac{256.54}{43.1} + \frac{5.345}{2} = 8.625$  c. ft.; less 25 per cent. for casualties, it equals 6.47 c. ft. of timber per annum.

### Third quality Sundri.

Calculation of I, the current annual increment for the average acre. (Based on the assumption that the diameter increment curve is similar in shape to that of second quality *sundri*):—

Diameter class.	Period taken to grow through the diameter class.	Increment of timber of the average tree during growth through the diameter class. (Taken from the volume table curve.)			Current annual increment for the average tree.	Timber volume of the average tree (vide Appendix IX).†	Volume of sound timber in the average acre. (Vide paragraph 46).	Current annual increment of timber in the average acre.
Inches.	Years.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
6 to 7	13.45	2.50	to	3.45 = .95	.0706	2.97	65.26	1.552
7 „ 8	15.65	3.45	„	4.45 = 1.00	.0639	3.93	39.65	.645
8 „ 9	30.24	4.45	„	5.45 = 1.00	.0331	4.97	21.56	.143
9 „ 10	100.00	5.45	„	6.35 = .90	.0090	5.90	12.26	.019
10 „ 11	..*	6.35	„	7.18 = .83	..*	6.77	6.02	..*
11 „ 12	..*	7.18	„	7.83 = .65	..*	7.53	3.17	..*
12, and over.	..*	.....*			..*	8.00	4.34	..*
Total ..							152.26	2.359

\*Period taken to grow 1 inch in diameter is very long; the current annual increment per acre is, therefore, negligible.  
†According to the special volume table for third quality forest in this working circle.

Calculation of the possible annual yield for the average acre :—

$V_p = 152.26$  c. ft.,  $I = 2.359$  c. ft. Rotation = 120.57 years, average age of a tree of 6 inches diameter = 97.12 years; therefore,  $p = 23.45$  years. Consequently, the yield of sound trees per acre =  $\frac{152.26}{23.45} + \frac{2.359}{2} = 7.673$  c. ft.; less 25 per cent. for casualties, it equals 5.75 c. ft. of timber per annum.

The yield for this quality is comparatively large, when compared with that of second quality, because the volume in the last age class is nearer normal. (Vide paragraph 50.) In the last plan, the same exploitable size was used for this quality as in the better qualities; hence, a greater proportion of mature trees has been left.

61. With the aid of the yields per average acre calculated in the previous paragraph, the annual yield of *sundri* timber from sound trees of 6 inches in diameter and over, has been calculated for the whole working circle. This yield, together with the yields of each felling series, is given in the following statement:—

Quality of forest.	The average annual yields for each felling series, as calculated from the yields of each type. [Vide Appendix IX, 5 (2).]				Total area of the working circle.	Total possible annual yield of the working circle.
	Felling Series 1.	Felling Series 2.	Felling Series 3.	Felling Series 4.		
	C. ft.	C. ft.	C. ft.	C. ft.	Acres.	C. ft.
First .. .. .	670,778	613,708	153,049	..	95,138	1,437,535
Second .. .. .	441,088	458,898	614,610	428,882	300,383	1,943,478
Third .. .. .	33,647	65,847	70,148	14,657	32,052	184,299
Maidan .. .. .	..	..	..	..	1,275	..
Total ..	1,145,513	1,138,453	837,807	443,539	428,848	3,565,312

The above yields, though merely estimates, may indicate greater accuracy than warranted by the data on which they are based; they are therefore approximated to the nearest lakh of cubic feet for the circle, as follows:—

1,150,000	1,150,000	850,000	450,000	428,848	3,600,000
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62. **The calculation of the yield of gengwa and passur.**—For similar reasons to those indicated for *sundri* in paragraph 58, it is proposed to prescribe the yield of *gengwa* and *passur* only for timber obtained from apparently sound trees of 6 inches diameter and over. The rotations for these species are merely estimates, and the shape of the diameter increment curves are unknown; Hufnagel's formula is therefore not practicable; but as it is important to have some sort of approximate check on the felling of these two species, their yield has been calculated according

to the formula  $Y = \frac{rV_p}{p(r - \frac{1}{2}p)}$ , where  $Y$  = the possible yield,  $V_p$  = the volume of

timber in the oldest age class of "p" period of years, and  $r$  = the rotation. (The formula is based on the principle of Von Mantel's formula  $Y = \frac{2V}{r}$ , where  $V$  = the volume of the whole growing stock.) With this method, it has been necessary to estimate only "p" and "r". It has been found with regard to the *sundri*, that

the equation chosen,  $Y = \frac{rV_p}{p(r - \frac{1}{2}p)}$ , gives a result within 3 per cent. of the total

yield of *sundri* for the whole working circle as worked out in the previous paragraphs; consequently, although the formula is actually one for the yield of mature trees only, it will give an approximately correct result in this case, and the thinnings may

be taken as equal to the casualties. The following table gives the details of the calculation of the yield:—

**The possible timber yield of gengwa and passur from sound trees of 6 inches in diameter and over.**

Quality class.	Volume of timber in sound trees of 6 inches diameter and over, in the average acre.	Estimated rotation (see paragraph 57).	*Estimated age of average tree of 6 inches diameter.	Period from 6 inches diameter to end of rotation.	Possible annual yield per acre according to the formula.	Number of acres in the working circle, in each quality.	Total possible annual yield of timber from sound trees of 6 inches in diameter and over.	
	C. ft.	Years.	Years.	Years.	C. ft.	Acres.	C. ft.	
<i>Gengwa.</i>								
First .. ..	78.27	114.5	63.8	50.7	1.98	95,138	188,373	
Second .. ..	61.69	110.0	66.3	43.7	1.76	300,383	528,674	
Third .. ..	62.14	105.5	74.7	30.8	2.36	32,052	75,643	
Total possible yield for the working circle or approximately ..								792,690 800,000
<i>Passur.</i>								
First .. ..	7.58	133.9	75.5	58.4	.166	95,138	15,793	
Second .. ..	31.97	133.9	75.5	58.4	.700	300,383	210,268	
Third .. ..	7.81	128.6	78.6	50.0	.194	32,052	6,218	
Total possible yield for the working circle or approximately ..								232,279 250,000

\*Estimated on the assumption that the diameter increment curves are similar in shape to those of *sundri* of the same exploitable diameter.

63. **The nature of the prescriptions for the yield.**—In this working circle, *sundri* is by far the most important and prolific species; consequently, the annual coupes prescribed in paragraph 69 of this chapter have been made with a view to equalising the outturn of *sundri*. With four felling series, it is probable that the total yield of other important species will not differ very much from year to year. The prescriptions for the annual coupes have been made by area. As the forests are not at all uniform in either quality or type, the area prescribed each year cannot be the same if the outturn is to be kept uniform. In Appendix IX, the possible annual yield per acre has been worked out for each type of forest, and by using these results, the annual yield for each compartment has been estimated. These estimates are believed to be approximately correct; with their aid, the annual coupes have been prescribed by areas which, each year, should have the same total possible outturn of timber from *sundri* trees of 6 inches diameter and over.

64. Although the prescriptions for the annual coupes have been made by area, it is considered necessary to prescribe some sort of check on the volume outturn; this check has been extended to *gengwa* and *passur*. (See paragraph 68.)

#### Method of Executing the Fellings.

65. **Nature of the fellings.**—Each felling will consist of the selection of mature stems, and the improvement of the crop; the latter will consist of the removal of defective stems, and the thinning out of young and middle-aged trees where necessary. As already illustrated in paragraph 50, the mature trees of *sundri* are still in deficit; consequently, there will be comparatively few mature trees available for felling, and the yield will consist mostly of thinning out the middle age classes. The same remarks apply to *passur*, but to a less extent. *Gengwa* has been heavily over-felled; for some years, the fellings will consist mainly of the removal of defective stems.

66. **Method and rules for marking.**—The following are the marking rules to be observed :—

(1) As a general rule, the fellings should be confined to the coupes prescribed in paragraph 69.

(2) First of all, a coupe should be divided up into sections of 40 acres each by making blazed, north and south, and east and west lines, one quarter of a mile apart. The lines should be surveyed and chained accurately, and at the end of each chain a stick should be placed with the number of the chain painted on it in coal-tar. With the aid of these lines, the coupe will be mapped on a scale of 4 inches to the mile. The courses of the small *khals* will be given on this map, and all inaccuracies of the present maps should be corrected.

(3) In order to obtain the best possible outturn from the forests, the exploitable diameters to be used for each small parcel of forest should be decided on separately. For this purpose, the table of exploitable diameters detailed in paragraph 39 will be used as a guide. Owing to the density of the growth and the prevalence of *shulas* or *pneumatophors*, the forest is very difficult to traverse. It would therefore be extremely laborious and expensive to make a rough survey of each section before starting to mark, in order to decide on the average maximum height and the corresponding exploitable diameters. In the light of experience, the Divisional Forest Officer will be able to decide on the best way to follow this rule in actual practice; the following method is suggested :—

With the aid of the map prepared as indicated in rule (2), the officer deputed to mark a section will prepare a rough sketch of it, about half foolscap size, and take it to the forest with him. The marking will proceed in strips of about one chain in width from one side of a section to the other. Before starting to mark, the marker will proceed down one side of the section and estimate at every five chains or so, the maximum height growth in the different parts of the first strip to be marked. He will indicate the places where his estimate alters with consecutively numbered pieces of paper inserted in cleft sticks, and note the number of the paper and his height estimates on his rough sketch map. He will then commence to mark the first strip, deciding the exploitable diameters to be used for each part of the line with the aid of his estimated heights and the table of exploitable diameters. At every five chains or so along the strip, he will stop marking and estimate the height of the next strip; he will indicate the point where he makes this estimate both on the ground and on his sketch map in the same way as before. Thus, when he has finished marking the first strip, the marker will be able to decide on the exploitable diameters for the second strip, and so on. The method indicated appears complicated, but in actual practice it has been found comparatively simple to carry out. Nevertheless, only subordinates trained at a forest school, or the more intelligent untrained foresters should be entrusted with this marking. If it becomes necessary to employ subordinates who cannot be trusted to estimate the maximum height of the trees with reasonable accuracy, a more reliable officer should decide on the average exploitable diameters of the whole section before such a marker starts his work; but if this is done, immature trees will be marked in the parts which are of better quality than the average, and over-mature trees will be left in the poorer parts of the section. As the quality of the forest changes considerably and continually from the banks of the small *khals* up to the *bils*, the number of immature trees marked and over-mature trees left would be very large. Thus much timber increment would be lost in the better quality patches, and in the patches of poorer quality there would be a large proportion of old, unsound trees by the time the next felling became due. In any case, it is important that the marking should be frequently inspected by a gazetted officer in order to see that no serious mistakes are being made.

(4) Revised stock maps on a scale of 4 inches to the mile are to be prepared for each coupe which is marked. Providing the method suggested in rule (3) is followed, the best method of preparing this stock map will be as follows :—

When preparing his rough sketch map of a section, the marker should draw east and west, and north and south lines at every 5 chains. With the aid of this network, and the numbers on the sticks denoting the end of each chain along the boundaries of the section, he will be able to indicate fairly accurately on his map, the positions from which he makes his height observations. These rough sketch maps, therefore, may be used to prepare a stock map giving the boundaries of each quality of forest with much more precision than on those prepared for this plan.

The types of forest shown on the stock maps should be the same as those shown on the maps already made. Except where there are obvious errors, the proportion of each species in the crop should not be revised. In the field, it may be more convenient to use colours for denoting the various types; but when the coupe is finished, two fair copies in black and white should be made with Indian ink on tracing cloth, using the key given in Appendix II. One of these fair copies should be kept in the Divisional Office and the other in the Ranger's office. When a whole compartment has been stock-mapped in this way, the maps are to be redrafted by the Conservator's draftsman, and printed. Eventually, by this means, detailed stock maps of the whole working circle will be available.

(5) Only the following species need be marked, namely, *sundri*, *gengwa*, *passur*, *dhundal*, *kankra*, *keora* and *baen*.

(6) The method of deciding the exploitable diameters has been described in rule (3), and a table prescribing the exploitable diameters for *keora* and *baen* in each compartment is given in paragraph 40. All trees which have reached these diameters should be marked, provided that their felling will not be contrary to rule (8).

(7) All unsound, badly shaped, or otherwise defective trees are to be marked, provided that their felling is not contrary to rule (8).

(8) The marking of a group of trees in one place, and the enlargement of an existing blank are to be avoided, except where regeneration has been established. This rule must not be understood as placing an embargo on the marking of single, large and spreading trees, which, inevitably, will cause a blank when felled.

(9) Middle-aged trees whose crowns are interlacing should be thinned.

(10) *Forked trees*.—The felling of one arm only of a forked tree should be avoided; the remaining arm generally becomes unsound.

(11) *Keora* in localities which have silted above the *keora* level, and which show signs of becoming stag-headed, should be marked. Similarly, any *baen* whose branches have been lopped for fuel should be felled, as such trees rapidly become hollow.

(12) Dead stems, which will not give even 7 feet length of sound timber, should not be marked.

(13) The wood of *gengwa* is soft and spongy, and is not at all durable; blazes very quickly produce rot, and ordinary marking hammer marks soon become effaced. Consequently, this species should not be blazed, but should be marked with a special type of marking iron, and the mark daubed with cheap red paint.

(14) All trees should be hammer-marked at a height of 4 feet 6 inches, and on the base. The base mark should be as low down as possible in order to economise in timber; in the case of *sundri*, it can be put on a buttress. Branches forking below 4 feet 6 inches should be given separate hammer marks, and listed as separate trees.

(15) Trees should be classed in 2 inches or 1 inch diameter classes on the sale list. No trees below 6 inches diameter should be marked for auction; such trees may be removed in subsidiary fellings. (See paragraph 71.) Each species should be listed separately, and unsound trees should be separated out from the sound trees on the sale list. The practice of classifying *passur* with *sundri* on the sale list should be discontinued. For the purpose of volume check, the quality class of all *sundri*, *gengwa* and *passur* trees of 6 inches diameter and over which are marked should be recorded.

(16) In order to prevent theft, each section should be marked with a hammer dissimilar to those used in the adjoining sections.

67. **Felling and coupe rules.**—The following rules are to be observed:—

(1) After a coupe has been marked, the trees as listed should be sold by auction, section by section. As at present *gengwa* cutters and merchants have no connection with the *sundri* cutters, it will probably be necessary to sell the *gengwa* separately, and have this species exploited first of all. It will be necessary, also, to reserve some of the *baen* and *dhundal* for selling on royalty rates, in order to supply any local demand by small purchasers.

(2) It is probable that some coupes will not sell readily in auction. The marked trees in these coupes may be extracted at royalty rates; but care should be taken that each tree felled is utilised to a reasonable extent, and that fair quality timber is not allowed to rot in the forest. It is suggested that, whenever possible, timber should be sold by the tree and not by the c. ft. or maund.

(3) If the demand for any species is in excess in any felling series, large boats should be made to go to coupes in other felling series, until the excess demand is worked off. Similarly, if extraction is in arrears, purchasers should be encouraged to come from other coupes. It is important that, as far as possible, small local boats should be allowed in the coupe which is most convenient for them.

(4) A year's coupes should not be delayed owing to the inability to sell all the available timber of any particular species: for example, the exploitation of *gengwa*, *baen*, *kankra* and other species should not be held up because of lack of demand for *sundri*. Any species thus left in arrear on old coupes may be worked off, if and

when the demand in any subsequent year exceeds the supply from the coupes prescribed for that year. Such arrears of felling can only be worked off, providing that the staff and boats necessary for the supervision of an extra coupe are available.

(5) It is expected that *gengwa* cutters will leave a sufficient number of trees containing defective timber for *jhools*, *mallams* and *khartchis*, etc., but if not, coupe officers will mark additional *gengwa* trees for this purpose, choosing defective or otherwise silviculturally removable trees if possible.

(6) Purchasers should be made to fell all marked trees which they have bought, irrespective of whether they wish to utilise them or not; but large hollow trees (such as is frequently the case with *keora*, *baen* and *passur*) which contain no exploitable timber may be girdled instead of felled, in order to lessen damage. A clause to this effect should be inserted on all sale notices. Gradually, in this way, useless and defective trees will be eliminated. An exception to this rule should be made in the case of *gengwa* for the purposes of rule (5). It will generally be necessary to allow fuel purchasers to fell large and spreading hollow *baen* trees, because of the large local demand for fuel of this species.

(7) Before loading their marked logs and poles into boats, purchasers will spread them out on *ghats* on the banks of rivers and *khals*. When the timber has been arranged on the *ghat*, the coupe officer will check the hammer marks, and mark the logs on the butt-end with the passing hammer. In this way, unmarked timber in loaded boats can easily be detected.

(8) Trees, which cannot be removed from the forest in one log, should have their upper portions hammer-marked before they are separated from the sale-marked log at the base; the coupe officer or his assistant will do this. Logs which have been dragged to the *ghat*, but are too large to load in the boats in one piece, should be half cut through by the purchaser; when the coupe officer is passing the logs on the *ghat*, they may be wholly separated, and both pieces hammer-marked on the butt-ends with the passing hammer.

(9) Whether sales are by auction or at royalty rate, the coupe officer will be responsible that payments are made when they are due, that no purchaser removes more timber than he has paid for, and that the terms of the agreement or permit are adhered to.

(10) The unregulated felling of species for which no exploitable diameter has been prescribed in Chapter I, will be allowed on royalty rates within the coupes for the year; but the felling of *goran*, *singra*, *khalsi*, and *kirpa* should be allowed only when the coupe is outside the zone of the *Goran Working Circle*, namely, only in Compartment Nos. 21 to 37 inclusive, and Compartment No. 40. The felling rules relating to *goran* and *singra* in paragraph 117(1) (b) and (2) of Chapter V, should be enforced as far as practicable.

(11) Fuel purchasers will be allowed to extract the tops left by the timber cutters at royalty rates, but they should not be allowed in a section until the timber purchasers have finished their extraction from it. Such extraction should be localised, and placed under the supervision of a forest guard. It is not practicable to define the difference between the poles and fuel of *amur*, as this species is used for *hookah* stems in very small sizes and lengths. The fuel of this species, therefore, will be sold at the royalty rate fixed for poles. As regards *goran*, the maximum length for fuel pieces should be 4 feet.

(12) Purchasers should be encouraged to cut *bhola* (*Hibiscus tiliaceus*), and other weeds. Such produce may be sold at very low, nominal rates.

(13) Dead stems and trees falling into rivers and *khals*, or those in danger of doing so, may be removed whenever and wherever possible, irrespective of whether they are in the coupes for the year or not. Unsound stems may be removed from the *goran* coupes prescribed for Working Circle IV. [See Felling rule (3) of paragraph 117.]

(14) Sometimes, on account of felling damage or for other reasons, sound trees of *sundri*, *gengwa* or *passur* of 6 inches in diameter and over, may be marked for felling in a coupe whilst the extraction is in progress. For the purpose of volume check, such trees should be recorded separately under their respective diameter and quality classes, in the same way as for the trees marked in the marking coupe.

68. **Application of volume check.**—The volume check concerns only *sundri*, *gengwa* and *passur*; the outturn of other species will be regulated solely by area. In the case of *sundri*, the total volume of timber in apparently sound trees of 6 inches in diameter and over, to be sold or extracted within the working circle, should not exceed the estimated yield of 3,600,000 cubic feet per year by more than 20 per cent., and the timber volumes of such trees sold or extracted from any one felling series or compartment, should not exceed the estimated yields detailed in paragraph 69 by more than 40 per cent. With regard to *gengwa* and *passur*, the total volume in apparently sound trees of 6 inches in diameter and over sold or extracted within the working circle, should not exceed by more than 30 per cent., the possible timber yields estimated in paragraph 62, namely, 800,000 cubic feet per year for *gengwa*, and 250,000 cubic feet for *passur*. The volumes of such trees sold or extracted, should be calculated according to the volume tables in Appendix V\*. If the volume output of *sundri* is more than the amount allowed according to this rule, it will indicate that markings have been too heavy. The reasons should be determined and necessary action taken to prevent a recurrence in following years. The coupes have been divided up with the idea of equalising the outturn of *sundri*; if the volume output of either *gengwa* or *passur* is in excess, it may indicate that there is more than the average volume available in the coupes of that particular year. Before assuming that the markings of these two species have been too heavy, the deficits, if any, of the former three years should be taken into account. If the volume output of either *gengwa* or *passur* is less than the estimate given, and there are no areas to be felled left in arrear, the coupes as prescribed may be worked over for the species concerned not more than one year in advance. No advance fellings of *sundri* should be allowed.

\*These volume tables are for apparently sound trees; the sample trees felled and measured for the preparation of these tables, sometimes proved to be unsound when felled. Consequently, all apparently sound trees should count towards the yield, whether they prove to be either sound or unsound when felled.

### Tabular Statement of Fellings to be made.

69. The statement on next page details the areas which should be felled over during the next twenty years, together with the estimated yield of timber from sound *sundri* trees of 6 inches diameter and over, from each coupe.

70. In these prescriptions, the estimated yields are based on approximations of the calculations of the annual yields for each compartment in Appendix IX, 5 (3). The yields expected from the coupes in each felling cycle do not remain the same each year, but the total estimated yield for the working circle is always equal to 3,600,000 cubic feet as calculated in paragraph 61. During the currency of the last plan, both *sundri* and other species were more heavily felled in Felling Series 1 than in the other felling series; for this reason, during the first five years, the coupes in this felling series have been made much smaller than the average, and those of Felling Series 2 have been made correspondingly larger. In Felling Series Nos. 3 and 4, *passur* is an important part of the crop. In order to maintain a continuous supply of this species, one of the coupes prescribed for any year in these two series, always contains an area in which *passur* is plentiful. The boundaries of the coupes prescribed have been shown on maps on a scale of 2 miles to the inch. (See Appendix XIV). The coupes in each felling cycle have been adjusted so that the compartments, or parts of compartments, prescribed in any one year are contiguous to one another, otherwise, during some years, unnecessary expense would have to be incurred for supervising two coupes in one felling series in different parts of the forest. This should be considered if, in the future, any alteration of the table of fellings to be made becomes necessary.

**Selection cum Improvements Fellings.**

(Prescribed in paragraph 69.)

Year.	Felling Series 1.			Felling Series 2.			Felling Series 3.			Felling Series 4.		
	Com- part- ment No.	Area to be felled over.	Estimated yield of <i>sundri</i> timber, from sound trees of 6 inches dia- meter and over.	Com- part- ment No.	Area to be felled over.	Estimated yield of <i>sundri</i> timber, from sound trees of 6 inches dia- meter and over.	Com- part- ment No.	Area to be felled over.	Estimated yield of <i>sundri</i> timber, from sound trees of 6 inches dia- meter and over.	Com- part- ment No.	Area to be felled over.	Estimated yield of <i>sundri</i> timber, from sound trees of 6 inches dia- meter and over.
1931-32 ..	1	9,102	950,000	15	7,480	1,350,000	30*	4,423	850,000	38	2,580	450,000
1932-33 ..	1	5,482	950,000	15 10	1,159 8,829	150,000 1,200,000	30* 31 32	530 4,957 2,928	100,000 500,000 250,000	38	2,589	450,000
1933-34 ..	1	3,255	900,000	15 10 9	4,481 4,368 2,368	650,000 550,000 200,000	31	6,552	850,000	38	2,588	450,000
1934-35 ..	1	3,556	900,000	15 12 14	241 5,173 3,689	50,000 650,000 650,000	31 32	4,022 1,945	700,000 150,000	38 40	1,836 774	350,000 150,000
1935-36 ..	1	3,374	950,000	14	6,260	1,400,000	32 33	7,757 1,542	700,000 150,000	40	2,479	400,000
1936-37 ..	1 2	320 5,819	100,000 1,150,000	27	4,214	1,050,000	33	6,401	850,000	40	2,655	450,000
1937-38 ..	2 3	7,499 1,186	1,100,000 100,000	27	4,245	1,100,000	33 34	4,093 584	750,000 100,000	40	2,625	450,000
1938-39 ..	3	7,082	1,250,000	27 28	998 3,077	300,000 700,000	34	4,818	850,000	40 35	1,418 1,177	300,000 200,000
1939-40 ..	3 4	5,585 2,839	1,000,000 200,000	28	4,207	1,100,000	34	5,117	850,000	35	3,098	450,000



940-41	..	4	12,429	1,250,000	28	2,775	800,000	34	2,196	400,000	35	4,530	450,000
1941-42	..	24	4,105	1,150,000	26	1,633	300,000	39	2,585	400,000	35	5,778	450,000
1942-43	..	24	4,286	1,100,000	26	5,803	1,150,000	39	4,680	850,000	35	1,532	150,000
1943-44	..	24	4,022	1,150,000	22	1,658	350,000	39	4,882	850,000	36	3,834	350,000
1944-45	..	12	8,934	1,300,000	22	3,141	800,000	16	3,352	600,000	36	4,132	450,000
1945-46	..	5	12,352	950,000	21	4,819	1,150,000	16	1,378	250,000	36	3,936	450,000
1946-47	..	6	17,659	1,050,000	21	3,346	900,000	16	4,868	850,000	36	3,277	450,000
1947-48	..	7	2,086	200,000	23	584	100,000	16	4,836	850,000	36	2,508	450,000
1948-49	..	11	11,052	1,100,000	23	5,532	1,350,000	29	4,061	1,000,000	36	2,512	400,000
1949-50	..	13	3,641	1,100,000	25	5,070	1,100,000	29	2,879	700,000	37	3,697	450,000
1950-51	..	13	6,128	1,400,000	25	5,968	1,200,000	29	3,061	850,000	37	2,438	400,000
	..	13	6,533	1,400,000	25	3,210	500,000	29	940	250,000	37	3,104	450,000
	..	13	6,533	1,400,000	25	1,244	400,000	30*	2,691	650,000	37		
	..	13	6,533	1,400,000	25	2,956	900,000	30*	4,460	850,000	37		
Total for 20 years	..		149,383	23,000,000		111,521	23,000,000		102,538	17,000,000		65,406	9,000,000

\* At the time of writing, *sundri* fellings in Compartment No. 30 are in progress under the prescriptions of the old plan; consequently, the coupes prescribed for the years 1931-32 and 1932-33, are the unfilled balance, and the coupes for the years 1949-50 and 1950-51 are in areas which have been felled during the currency of the old plan.

### Subsidiary Fuel Thinnings.

71. Whenever possible, over-crowded young *sundri* poles and saplings of under 6 inches in diameter should be thinned out by cleanings or subsidiary thinnings. On the coupes for the year, these fellings should follow up immediately after the main felling has been finished. The present *sundri* subsidiary thinning coupe will be retained, and will work, as before, in places where the Divisional Officer thinks most necessary. Forest guards will mark these thinnings with the aid of the fuel purchasers acting as marking coolies. No forest guards should be allowed to mark trees of over 6 inches in diameter, and their work should be closely supervised by the coupe officer. This type of felling is a very useful tending operation, which at the same time realises a small profit; the demand for this type of fuel should be encouraged. If purchasers can be found, the thinnings should be made to include poles of *gengwa*, *passur* and other species.

### General Estimate of the possible Annual Outturn from all Species.

72. In paragraphs 59 to 62 inclusive, the yields from trees of 6 inches in diameter and over of the three principal species have been calculated, and prescriptions based on them have been made in paragraph 68. The following is merely an estimate of the possible annual outturn from trees of all species and sizes, under the treatment prescribed :—

Species.	Estimated possible annual yields.					
	Timber.			Fuel.		
	From sound stems.	From unsound stems.	Total.	From sound stems.	From unsound stems.	Total.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
<i>Sundri</i> ..	5,250,953	9,111	5,260,064	1,689,720	74,206	1,763,926
<i>Gengwa</i> ..	1,614,935	733	1,615,668	587,083	5,892	592,975
<i>Passur</i> ..	273,224	958	274,182	98,451	9,249	107,700
<i>Dhundal</i> ..	2,223	17	2,240	1,839	989	2,828
<i>Kankra</i> ..	124,424	68	124,492	43,612	553	44,165
<i>Keora</i> ..	169,746	242	169,988	86,370	2,409	88,779
<i>Baen</i> ..	111,169	7,269	118,438	87,652	66,274	153,926
<i>Amur</i> ..	143,151	64	143,215	301,268	599	301,867
<i>Goran</i> ..	7,323	..	7,323	2,132	..	2,132
<i>Singra</i> ..	..	..	..	96,920	754	97,674
<i>Khalshi</i> ..	12,061	12	12,073	21,775	125	21,900
Other kinds ..	34,334	78	34,412	39,636	997	40,633
Total ..	7,743,543	18,552	7,762,095	3,056,458	162,047	3,218,505

73. The methods used for making these estimates will be found in Appendix IX. They are intended merely to give an idea of the possibility of the working circle. It should be remembered that most of the rotations, and some of the volume tables used for the calculation of these figures are very rough estimates; also only a small proportion of the forest was enumerated to obtain the estimates of the average stocking of each species per acre.

## CHAPTER III.

THE SCHEME FOR WORKING CIRCLE II OR THE MODERATELY  
SALT-WATER WORKING CIRCLE.

## The General Composition and Analysis of the Crop.

74. **The composition of the crop.**—This working circle consists of the forests in the moderately salt-water zone. The crop and character of the vegetation of this zone has been described in paragraphs 42 to 44 inclusive of Part I. The crop is mainly of third quality; but areas of second quality forest occur, particularly in Felling Series 1. As the boundaries of the second quality forests are not demarcated on the ground, it is not practicable to include these areas in Working Circle I. Similarly, areas of fourth quality forest occur, which can be worked more conveniently under the prescriptions for this circle. *Sundri* and *gengwa* are the principal species; in Felling Series 1, the proportions of these two species are about equal; in Felling Series 2, *sundri* predominates; in the poorer forests of Felling Series 3 and 4, the proportion of *sundri* dwindles, and *gengwa* becomes the predominant tree. The next species in importance is *passur*; other important exploitable species which are fairly common, are *keora*, *baen*, *dhunda*, *kankra* and *amur*. *Goran* is abundant throughout practically the whole circle, and is particularly dense in Felling Series 3 and 4, but as prescribed in Chapter I, this species is to be worked under the prescriptions for Working Circle IV. The following statement classifies the circle into the various types of forest according to the stock maps:—

Type of Forest.	Felling Series No. 1.	Felling Series No. 2.	Felling Series No. 3.	Felling Series No. 4.	Total.
	Acres.	Acres.	Acres.	Acres.	Acres.
<b>Second quality (35 feet to 50 feet height growth).</b>					
Forests with very little <i>goran</i> —					
<i>Sundri</i> mixed with <i>gengwa</i> .. ..	..	..	1,586	1,756	3,342
<i>Sundri</i> and <i>gengwa</i> mixed with <i>passur</i> or <i>kankra</i> .. ..	..	..	8,894	..	8,894
<i>Sundri</i> mixed with <i>passur</i> .. ..	..	132	..	..	132
<i>Keora</i> .. ..	660	97	..	..	757
Forests with understory of <i>goran</i> —					
Pure <i>sundri</i> .. ..	..	1,034	..	..	1,034
<i>Sundri</i> mixed with <i>gengwa</i> .. ..	33,836	..	..	..	33,836
<b>Total second quality forest .. ..</b>	<b>34,496</b>	<b>1,263</b>	<b>10,480</b>	<b>1,756</b>	<b>47,995</b>

Type of Forest.	Felling Series No. 1.	Felling Series No. 2.	Felling Series No. 3.	Felling Series No. 4.	Total.
	Acres.	Acres.	Acres.	Acres.	Acres.
<b>Third quality (20 feet to 35 feet height growth).</b>					
Forests with very little <i>goran</i> —					
<i>Sundri</i> mixed with <i>gengwa</i> .. ..	..	6,443	..	..	6,443
<i>Sundri</i> mixed with <i>gengwa</i> , <i>passur</i> , <i>kankra</i> and <i>baen</i> .. ..	..	..	3,310	1,408	4,718
<i>Sundri</i> mixed with <i>passur</i> .. ..	..	114	..	..	114
<i>Gengwa</i> mixed with <i>passur</i> .. ..	..	..	..	1,190	1,190
<i>Keora</i> .. ..	742	..	65	37	844
<i>White baen</i> .. ..	..	..	..	157	157
Forests with understory of <i>goran</i> —					
Pure <i>sundri</i> .. ..	..	3,619	..	..	3,619
<i>Sundri</i> mixed with <i>gengwa</i> .. ..	58,564	137,535	4,729	5,681	206,509
<i>Sundri</i> and <i>gengwa</i> mixed with either <i>passur</i> , <i>kankra</i> , <i>dhundal</i> or <i>baen</i> .. ..	887	..	10,750	11,785	23,422
Pure <i>gengwa</i> .. ..	7,732	..	2,416	4,312	14,460
Standards of the following species over <i>goran</i> —					
<i>Sundri</i> mixed with <i>gengwa</i> .. ..	8,888	41,721	59,881	6,959	117,449
<i>Sundri</i> and <i>gengwa</i> mixed with <i>passur</i> .. ..	..	..	..	2,041	2,041
<i>Gengwa</i> .. ..	3,460	..	15,269	48,803	67,532
Sparse standards of the following species over <i>goran</i> —					
<i>Sundri</i> mixed with <i>gengwa</i> .. ..	..	..	12,482	9,279	21,761
<i>Sundri</i> and <i>gengwa</i> mixed with <i>passur</i> .. ..	..	..	..	7,543	7,543
<i>Gengwa</i> .. ..	755	..	2,507	23,267	26,529
Total third quality forest .. ..	81,028	189,432	111,409	122,462	504,331
<b>Fourth quality (under 20 feet height growth).</b>					
<i>Kankra</i> and <i>baen</i> , without <i>goran</i> .. ..	..	..	..	143	143
Standards of <i>gengwa</i> over <i>goran</i> .. ..	1,727	..	..	..	1,727
Sparse standards of the following species over <i>goran</i> —					
<i>Sundri</i> and <i>gengwa</i> .. ..	..	..	3,777	974	4,751
<i>Sundri</i> , <i>gengwa</i> and <i>passur</i> .. ..	..	..	..	2,536	2,536
<i>Gengwa</i> .. ..	1,932	..	846	18,658	21,436
<i>Goran</i> without standards .. ..	..	..	..	143	143
Total fourth quality forest .. ..	3,659	..	4,623	22,454	30,736
Blanks or maidan .. ..	482	44	263	370	1,159
Total area .. ..	119,665	190,739	126,775	147,042	584,221

NOTE.—Although this working circle is not concerned with *goran*, in the foregoing statement the forests have been classified according to the stocking of this species, because the density of the *goran* gives an indication, in an inverse way, of the density of the overcrop. (Vide Appendix II.) Forests with an understory of *goran* contain over 350 trees of other species, of 3 inches diameter and over, per acre; forests consisting of standards over *goran* contain 200 to 350 trees per acre; and sparse standards over *goran* indicate less than 200 trees of other species, of 3 inches diameter and over, per acre.

75. **The condition of the crop and type of produce available.**—During the currency of the last plan, the exploitation of *sundri*, *passur*, *kankra*, *keora* and *amur* was neglected; fellings on regular coupes were made only in Compartments Nos. 7, 16, 17 and 18. Many trees of these species, therefore, are ripe for felling. On the other hand, the species which have been open to unregulated felling during the last plan, namely, *gengwa*, *baen*, *dhundal* and other kinds, have been much over-cut; the yield from these species will consist mostly of unsound and defective trees. The distribution of the age classes in the *sundri* crop appears to be similar to that of the third quality forest in Working Circle I, and may be considered as approximately normal; but in the *gengwa* crop, despite the smaller exploitable diameters in this circle, the deficiency in the older age gradations is just as marked as in the *gengwa* of Working Circle I. As regards *baen* and *dhundal*, the very high proportion of unsound trees enumerated illustrates the deplorable state of the stocking of these two species.

76. Owing to the prevalence of *goran* throughout the working circle, and the large patches of useless scrub which frequently occur in the more southern parts of Felling Series 3 and 4, the density of the stocking is not comparable with that of the forests within Working Circle I. This sparse stocking is the normal state of the forest; *goran* is the most suitable crop to grow in most parts of these moderately salt areas, and the dryish saline soils beneath the areas of scrub will not support a better crop. The mature sizes of most species are much smaller than those of the fresh-water forests in Working Circle I, and the timber available for felling will be mostly of pole size; but there will be a fairly large supply of large *keora* for planking, which will compensate for the shortage of sound and mature *baen*. For some years, there will be a considerable supply of unsound *baen* for fuel, hollow logs for using as sluices to *bunds*, etc. *Sundri* and *passur* poles will compensate for the shortage in *dhundal*.

77. **Volume of the growing stock.**—The working circle contains three qualities of forest, namely, second, third and fourth. The results of the enumerations over each of these three qualities, will be found in Appendix IX. In a similar manner to that used for Working Circle I, these enumerations have been converted into estimated volumes per acre, which are tabulated on pages 114 and 115.

78. In addition to the volumes given on the succeeding pages, the following are the average volumes per acre in sound trees of *keora* and *baen* for the whole working circle:—

	Timber · Fuel.	
	C. ft.	C. ft.
<i>Keora</i> (3 inches diameter, and over)	.. 18·95	11·02
<i>Baen</i> (3 inches diameter, and over)	.. 5·67	8·14

The volume of *amur* in stems of 3 inches in diameter and over, has been included under the heading "other kinds" in the average volumes per acre given overleaf. This species is utilised in small sizes; the estimated average volume per acre for the working circle in sound *amur* stems of 1 inch in diameter and over is 6·73 cubic feet consisting of 0·75 cubic feet of poles and 5·98 cubic feet of fuel. (See details of enumerations and calculations in item 11 of Appendix IX.)

79. Although the main proportion of each felling series is third quality forest, it must be remembered that this quality class is a very comprehensive one; also, it is a classification according to the average maximum height of the trees, and has no reference to the density of the crop. Consequently, there is a vast difference between the volume per acre in Felling Series Nos. 1 and 2, and Felling Series Nos. 3 and 4. In the third quality forests of Felling Series Nos. 1 and 2, the enumerations show an average of 208 *sundri* and 204 *gengwa* trees of over 3 inches diameter per acre; in Felling Series Nos. 3 and 4, the corresponding averages are only 27 and 188 respectively; the volumes of timber per average acre show an even greater divergence. (See volumes per acre worked out from the enumeration results, compartment by compartment, item 13 of Appendix IX.)

## Second quality forest (volumes of apparently sound trees per acre).

(Reference paragraph 77.)

Diameter class.	Sundri.		Gengwa.		Passur.		Dhandal.		Kankra.		Other kinds.*	
	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.
Inches.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
3 to 4	75.63	50.42	..	117.90	1.31	.67	.21	.14	.87	.43	.78	1.12
4 " 5	75.33	27.29	70.81	40.46	2.45	.54	.31	.06	.96	.32	.29	.31
5 " 6	50.82	15.69	60.51	19.26	2.34	.68	.24	.07	.86	.26	.21	.18
6 " 7	29.59	8.79	30.30	7.57	2.11	.67	.17	.10	.81	.25	.04	.04
7 " 8	15.06	4.62	15.60	3.67	2.24	.77	.10	.10	.19	.06	.10	.10
8 " 9	9.71	2.84	7.92	1.93	2.65	1.04	.08	.14	.29	.08	.08	.08
9 " 10	3.09	.98	3.35	.89	1.98	.76	.04	.10	.14	.04	.11	.11
10 " 11	1.35	.49	1.85	.61	1.48	.58	.03	.15	.09	.02	..	..
11 " 12	.83	.33	.58	.25	.56	.21	.00	.26	..	..	.05	.05
12 " 13	.42	.17	.36	.17	.55	.27	..	..	..	..	..	..
13 " 14	.34	.17	.10	.05	.16	.09	.00	.06	..	..	..	..
14 and over	.24	.15	.11	.05	.34	.22	.00	.45	.15	.12	.05	.05
Total	263.01	111.94	191.49	192.81	18.17	6.50	1.18	1.63	4.36	1.58	1.71	2.04

NOTE.—The second quality forest in the working circle is of considerably inferior quality to the average of this quality class; also many patches of third quality forest, too small to stock map, have been included in these enumeration figures. (See footnote to table for third quality forests in Working Circle I, paragraph 46). Consequently the volumes of *sundri*, *gengwa* and *passur* in the above table, have been calculated at rates about midway between that of the average second quality forest and the rates used for the third quality forest in Working Circle I; the special volume table used is given in Appendix IX, item 9, beneath the enumeration results for this quality of forest. The volumes of the other species have not been revised, because their exploitable diameters and rotations do not differ so much between the second and third quality classes.

\*The figures for "other kinds" do not include *kozra* and *baen*, or the species which are to be worked under the prescriptions of Working Circle IV.

Third quality forest (volumes of apparently sound trees per acre).

Diameter class. Inches.	Sundri.		Gengwa.		Passur.		Dhondal.		Kankra.		Other kinds.*	
	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
3 to 4	26.10	37.38	64.41	.11	.56	.32	.22	.42	.21	.61	.74	
4 " 5	32.06	16.16	31.30	.19	.81	.36	.06	.45	.12	.27	.29	
5 " 6	25.48	8.32	25.52	.26	.86	.20	.06	.48	.11	.21	.19	
6 " 7	14.26	4.08	15.35	.15	.92	.15	.09	.33	.10	.17	.16	
7 " 8	6.29	1.87	7.42	.07	1.04	.07	.07	.25	.07	.15	.15	
8 " 9	2.83	.84	1.24	.04	.45	.08	.13	.15	.05	.13	.13	
9 " 10	1.43	.68	1.96	.04	.92	.04	.10	.12	.05	.08	.08	
10 " 11	.57	.37	.97	.40	.64	.03	.19	.08	.05	.07	.07	
11 " 12	.34	.27	.50	.28	.49	..	.19	.07	.07	.04	.04	
12 and over	.25	.20	.30	.19	.53	..	.44	.12	.12	.04	.04	
Total	110.51	70.17	87.28	112.48	7.81	3.40	1.25	1.55	2.47	.95	1.77	1.89

Fourth quality forest (volumes of apparently sound trees per acre).

3 to 4	.70	3.39	..	39.06	.16	.04	.24	.09	.49	.20	.08	.44
4 " 5	1.21	.68	14.88	11.90	.39	.10	.20	.10	.13	.03	.18	.21
5 " 6	.71	.25	7.91	3.52	.39	.13	.16	.09	.19	.05	.22	.14
6 " 7	.25	.09	3.68	1.98	.54	.25	.07	.05	.10	.04	.11	.07
7 " 8	.11	.07	1.02	.70	.25	.17	.05	.06	.14	.05	.09	.07
8 " 9	.04	.03	.29	.21	.46	.48	..	..	.12	.06	.11	.13
9 " 10	.05	.03	.34	.25	.23	.39	..	..	..	..	.07	.11
10 " 11	..	..	.04	.03	.05	.20	..	..	..	..	.05	.09
11 " 12	..	..	..	..	.03	.13	..	..	..	..	.02	.07
12 and over	..	..	..	..	.02	.07	..	..	..	.06	..	..
Total	3.07	4.54	28.16	57.65	2.52	1.96	.72	.39	1.19	.49	.93	1.33

NOTE.—For similar reasons to those given in the last note to the table of average volumes per acre in third quality forests of Working Circle I (paragraph 46), the fourth quality forest in this working circle is of better quality than the average fourth quality forest for the division. Consequently, the volumes of *sundri*, *gengwa*, *passur* and *kankra* in the above table, have been calculated at a higher rate than the average fourth quality forest; the special volume table will be found in Appendix IX, item 9.

\*The figures for "other kinds" do not include *keora* and *basa*, or the species which are to be worked under the prescriptions of Working Circle IV.

### Method of Treatment.

80. **The silvicultural system.**—Wherever the soil is suitable and browsing by deer is not too severe, regeneration of both *sundri* and *gengwa* is prolific under the standing forest. *Gengwa* seedlings appear to stand desiccation better than those of *sundri*, but not sufficiently to justify anything approaching a clear felling. Accordingly, the system of "Selection cum Improvement Fellings" prescribed for Working Circle I, has been adopted for this working circle also.

81. **The felling cycle.**—In the former plan, the greater portion of the *sundri* forests in what is now Felling Series 1 and 2, was worked on a felling cycle of 40 years. This was too long a period. Although the growth in this circle is slower than in Working Circle I, it must be remembered that both the exploitable ages and sizes are smaller. With too long a felling cycle, there are two alternatives, namely:—to lower the exploitable ages and sizes, and make the fellings excessively heavy, or to incur a heavy wastage, because of trees becoming over-mature while waiting for felling. However, as the forests are mostly much more open than those of Working Circle I, they will not need such frequent attention for thinnings. Accordingly, a felling cycle of 30 years has been chosen; with this period, the rotation will not be unduly lengthened, and at the same time the fellings will be fairly well concentrated.

82. **The rotations.**—The felling cycle has been fixed at 30 years; consequently, the estimated average age of the mature trees felled, namely, the average rotation, should be 15 years more than the exploitable age. It has been pointed out in the foot-notes to the tables of estimated volumes per acre given on pages 114 and 115, that the second quality forest in this working circle is of inferior quality to the average of this quality class, and that the fourth quality forest is on the average of better quality than the average of its quality class. For this working circle, therefore, the average exploitable diameter of second quality *sundri* has been estimated at 8 inches, corresponding to an age of 113.2 years, that of second quality *gengwa* at 9 inches, corresponding to an age of 97.7 years, and that of second quality *passur* has been estimated at 11 inches, corresponding to an estimated age of 121.2 years. Similarly, the average exploitable diameter of fourth quality *sundri* has been estimated at 4 inches, corresponding to an estimated age of 102.6 years, that of fourth quality *gengwa* at 5 inches, corresponding to an estimated age of 88.7 years, and that of fourth quality *passur* and *kankra* has been estimated at 7 inches corresponding to an estimated age of 110.6 years. Accordingly, under the treatment prescribed, the rotations of the seven principal species in the working circle will be as follows:—

Species.	Rotations in years.		
	Second quality.	Third quality.	Fourth quality.
<i>Sundri</i> .. .. .	128	123	118
<i>Gengwa</i> .. .. .	113	108	104
<i>Passur</i> .. .. .	136	131	126
<i>Dhundal</i> .. .. .	123	123	120
<i>Kankra</i> .. .. .	131	131	126

Average rotations for the whole circle:—*Keora*, 95 years: *Baen*, 175 years.

83. **The allotment of the annual coupes.**—*Sundri* and *gengwa* are the two most common species in this working circle, and their timber is the most important produce to be exploited. For this reason, the annual coupes have been prescribed with the idea of maintaining an equal supply of the timber of both these species every year. Previous to the enumerations, none of the *gengwa* and only a portion of the *sundri* had been exploited on the coupe system. Consequently, one must consider the increment in volume which will accrue in the coupes of each succeeding year, before they are felled over. The forests in which *sundri* has not previously been felled over on the coupe system, have been closed to the felling of this species during the last 28 years; before being felled over, therefore, the increment of *sundri* timber



in these areas will be mostly balanced by the casualties in the over-mature trees.\* *Gengwa*, on the other hand, has been much overfelled; consequently, there will be a considerable increase in the volume of this species in compartments which are not felled over until towards the end of the felling cycle. This increase should be allowed for, if the expected yield of each coupe is based on the enumeration results of the compartment in which it is situated; but, during the *interim* period between the years 1926-1928 when the enumerations were made, until the 1st April 1931 when this plan is due to come into force, the output of this species is being restricted and confined to coupes, in which only trees of 2 feet 6 inches girth and over are allowed to be felled. In most of the compartments which are not due to be felled over until the second half of the 30-year felling cycle, light *gengwa* fellings of this type have either been made or are expected to be made before this plan comes into force: but no *gengwa* fellings have been made or are expected to be made during this *interim* period, in coupes which are due for felling in the first half of the cycle under the treatment proposed in this plan. These subsequent fellings, therefore, will more or less counterbalance the increase in volume of *gengwa* timber to be expected before felling in compartments which are not due to be felled until towards the end of the felling cycle, and, on the average, the expected yield from each coupe may be assumed to be roughly proportional to its volume during the years 1926-1928, when the enumerations were made, or in other words, its volume based on the enumeration results of the particular compartment in which the coupe is situated. In the case of *sundri* it has been pointed out that the increase in volume will be very little; after making allowances for the few compartments which have been felled over, the expected yield of this species from each coupe, also may be assumed to be proportional to its total volume based on the enumeration results of the compartment concerned. On this assumption, the possible yields of sound *sundri* and *gengwa* timber have been estimated for each compartment; these estimations are given in Appendix IX. With their aid, the annual coupes in paragraph 87 of this chapter have been so arranged that the total expected outturn of both *sundri* and *gengwa* timber from each set of annual coupes in the four felling series will be uniform throughout the period of this plan. The felling of other species will be confined to the coupes prescribed for *sundri* and *gengwa*; with annual coupes in four felling series, together with the coupes of other working circles, it is not likely that the volume of these other species available for felling will vary very much from year to year.

84. The annual coupes have been prescribed by area. As it will not be possible to mark all the coupes before felling [*vide* paragraph 86 (1)], it will be extremely laborious and expensive to record the species, diameter class and quality of each tree felled. Consequently, any sort of prescription restricting the volume of the outturn is not practicable. However, unless the degree of utilisation becomes much more complete than at present, and the minimum sizes used for the preparation of the volume tables in Appendix V become unsuitable, the possible outturn of *sundri* and *gengwa* estimated in paragraph 89 of this chapter, will act as some sort of indication as to whether over-felling is occurring or not.

### Method of Executing the Fellings.

85. **Nature of the fellings.**—As far as is practicable, the fellings in this working circle will be of the same nature as those in Working Circle I; excepting for *baen*, *gengwa* and *dhundal*, there will be a comparatively larger yield of mature trees, but their sizes will be much smaller. The quality or the stocking of a large proportion of the area, particularly in the Satkhira Range, is too poor to pay for marking. The best way to work such areas, will be to allow purchasers to remove trees which have reached the exploitable size; the removal of defective trees of smaller size may be allowed only when sufficient supervision is available, and a demand exists.

86. **Marking, felling and coupe rules.**—The marking, felling and coupe rules prescribed for Working Circle I, apply also to this working circle, with the following exceptions and remarks:—

(1) There are no prescriptions regarding the volume of the export of any species; the annual coupes tabulated in paragraph 87 are prescribed solely by area. The

\* The areas which have not previously been felled over on the coupe system for *sundri*, are in the west, namely, Felling Series Nos. 3 and 4; these forests are far too sparsely stocked with *sundri*, to make an extra coupe for the felling of the over-mature trees an economical proposition.

coupes for the year will be stock-mapped and divided up into sections in the same way as has been prescribed for Working Circle I, but marking need not be done in large blocks of poor fourth quality forests, and in areas of better height growth where the overcrop is too sparse, or the undergrowth too thick to make marking a reasonable proposition. As far as possible, sections should be arranged to contain only forest fit for marking, or only poor unmarkable forest. Those containing the unmarkable forests may be made larger than 40 acres each : for example, the east and west lines may be made half a mile apart, instead of a quarter of a mile. In the poorer sections, the marking officer will prepare a more detailed stock map and fix the exploitable diameters for each unmarked plot.

(2) *Gengwa mathals* consisting of areas of poor hard clay of comparatively low elevation growing a very sparse crop of indifferent *gengwa*, and other areas devoid of undergrowth with a very sparse crop, are probably too poor to support a denser one. Weeds do not grow in these areas ; consequently, trees which have reached the exploitable diameter on such areas may be felled, irrespective of the fact that the canopy is already very open. The same remark applies to the poor fourth quality forests, where the so-called undergrowth is *hantal*, which is itself exploitable and produces a certain amount of revenue.

(3) In the sections which are too poor for marking, purchasers on royalty rates may be allowed to extract whatever has reached the exploitable diameter. In such sections, defective trees of less diameter, and tops of felled trees may be removed whenever demand and supervising staff is available. As an exception to this rule, any *keora* or *baen* in unmarked sections should not be felled until the coupe officer, or his assistants have hammer-marked them as silviculturally removable ; for this they will be guided by the felling rules of Working Circle I combined with the preceding rule (2).

(4) The trees being mostly of small growth in this working circle, fuel and small house-posts will form a more important part of the yield ; consequently, trees in the markable sections will be marked in 2 inches diameter classes down to 3 inches in diameter. Every effort should be made to foster the demand for small *sundri* for axles, house-posts, fuel, etc. The same remark applies to small *gengwa* for dunnage, fuel for *hookah* charcoal, etc. It is not expected that the demand for this small stuff will be sufficient to clear the whole of the coupes for any one year ; it will not be necessary, therefore, to mark the whole coupe down to 3 inches in diameter, but only for such portion, for which a demand is expected ; the remainder of the coupe may be marked with a larger minimum diameter, fixed according to the demand. Purchasers of small poles of *sundri*, *gengwa*, *passur*, *dhundal*, *kankra*, *keora* or *baen*, should be induced to fell in the marked areas, in preference to the unmarked areas.

(5) Probably, it will not be possible to sell by auction any appreciable quantity of the *sundri* on the coupes of this working circle ; until the demand equals the supply, sales on royalty rates will be preferable. On the other hand, it will most likely be possible to auction the marked *passur*, *keora*, *baen* and the larger sized *gengwa*, as soon as the traders can be induced to accept this system.

### Tabular Statement of Fellings to be made.

87. In order to equalise the expected outturn of both *sundri* and *gengwa* timber each year, it has been necessary to prescribe two coupes in Felling Series No. 2, namely, one for *gengwa* and one for *sundri* and other species. In some cases, by marking the *sundri* and other species one or two years in advance, it will be possible to economise by marking the *gengwa* along with the *sundri* ; but, in the coupes marked with an asterisk in the tabular statement, separate *gengwa* marking will be required. From 1935-36 to 1947-48, the *gengwa* coupe in this felling series will generally be widely separated from the coupe for other species, and will require separate management. It is not expected that these extra *gengwa* coupes will take more than two or three months to exploit ; consequently, the *gengwa* may be felled before the *sundri* coupe is opened, or, if this should not be expedient, the extra supervision and expenditure required for this extra coupe will be very small.

Year for which prescribed.	Coupes to be felled over.									
	Felling Series 1.		Felling Series 2.				Felling Series 3.		Felling Series 4.	
	For all species.		For all species excepting <i>gengwa</i> .		For <i>gengwa</i> only.		For all species.		For all species.	
	Comp. No.	Area.	Comp. No.	Area.	Comp. No.	Area.	Comp. No.	Area.	Comp. No.	Area.
	Acres.		Acres.		Acres.		Acres.		Acres.	
1931-32 ..	45	4,706	19	5,156	19	6,219	46	2,799	55	4,390
1932-33 ..	45	4,705	19	5,157	19	6,219	46	2,799	55	4,390
1933-34 ..	45	4,706	19	5,156	19	6,219	46	2,799	55	4,389
1934-35 ..	45	4,705	19	4,260	19	1,072	46	2,799	55	4,390
			20	620	20	6,006				
1935-36 ..	45	4,706	20	3,570	42*	5,082	46	2,799	55	4,390
1936-37 ..	45	3,708	20	3,443	20	7,770	46	2,800	55	4,390
	8	1,073								
1937-38 ..	8	5,062	20	2,971	42*	6,774	46	2,799	55	4,389
1938-39 ..	8	5,062	20	2,971	20	5,327	46	2,799	55	4,390
					38*	6,269				
1939-40 ..	8	5,062	20	2,971	42*	6,603	46	2,799	55	4,390
					41*	218				
1940-41 ..	8	5,062	20	2,557	41*	8,641	46	2,799	55	2,930
			38	390					49	1,699
1941-42 ..	8	5,369	38	3,030	44*	4,900	54	5,466	49	5,166
1942-43 ..	8	5,369	38	3,030	38	486	54	5,466	49	5,165
					37	2,369				
					41*	6,166				
1943-44 ..	8	669	38	305	44*	4,656	54	5,467	49	5,165
	9	3,733	37	2,369						
			41	269						
1944-45 ..	9	4,264	41	7,937	41	3,221	54	5,467	49	5,166
					44*	2,425				
1945-46 ..	9	4,264	41	7,938	44*	4,622	54	5,466	49	5,166
1946-47 ..	9	4,264	41	2,102	44*	4,720	54	5,466	49	1,289
			42	18,459					48	5,861
1947-48 ..	9	3,675	44	11,306	44	3,597	54	2,009	48	7,810
					43*	1,546	53	3,871		
1948-49 ..	9	3,675	44	11,349	43	4,936	53	6,120	48	6,478
									47	521
1949-50 ..	9	3,675	44	2,265	43	5,305	53	6,120	47	3,052
			43	8,037						
1950-51 ..	9	2,018	43	9,541	43	5,791	53	4,598	47	3,052
	10	1,599					52	1,010		
Total for 20 years	..	91,131	..	127,159	..	127,159	..	84,517	..	98,028

\*Separate *gengwa* marking required.

88. The estimated yields of *sundri* and *gengwa* timber from the coupes prescribed in the foregoing statement, may be found in item 16 of Appendix IX. In Felling Series Nos. 1, 3 and 4, the total estimated timber yield from *sundri* and *gengwa* added together, is practically uniform each year. The total expected yield of timber of these two species from the coupes prescribed throughout the working circle, comes to 1,397,601 cubic feet of *sundri*, and 1,388,064 cubic feet of *gengwa* each year: as previously stated, the coupes of Felling Series No. 2 have been adjusted so as to maintain this unvarying supply of both kinds of timber. In Felling Series Nos. 2, 3 and 4, two-thirds of the area have been prescribed for felling within the 20 years. In the aggregate, this two-thirds was found to contain a stocking of somewhat below the average for these three felling series; consequently, in order to keep the total yield of the working circle approximately near to what the average yield should be for the 30-year felling cycle, a larger proportion than two-thirds of the area has been fixed for felling in Felling Series I during the next 20 years: this adjustment was found to be the most convenient one, and the one which brought the expected yields of both *sundri* and *gengwa* nearest to the estimated averages for the whole felling cycle. Areas on the sea-face, and islands in the larger estuaries are generally inaccessible except during the calm season; for such places, the annual coupes have been divided into two parts, one of which is intended to be worked in the calm season, and the other, during the monsoon. The boundaries of the coupes have been shown on maps on a scale of 1 inch equals 2 miles. [See item 1 (3) of Appendix XIV.]

### General Estimate of the possible Annual Outturn from all Species.

89. The methods used for estimating the possible annual yields from each species under the treatment prescribed, are given in Appendix IX; the following statement summarises the results:—

Species.	Estimated possible annual yields.					
	Timber.			Fuel.		
	From sound stems.	From unsound stems.	Total.	From sound stems.	From unsound stems.	Total.
	C.ft.	C.ft.	C.ft.	C.ft.	C.ft.	C.ft.
<i>Sundri</i> ..	1,397,601	4,151	1,401,752	842,426	35,911	878,337
<i>Gengwa</i> ..	1,388,064	1,392	1,389,456	736,254	12,786	749,040
<i>Passur</i> ..	83,076	412	83,488	35,574	4,218	39,792
<i>Dhundal</i> ..	15,047	154	15,201	18,435	6,509	24,944
<i>Kankra</i> ..	25,617	47	25,664	9,806	453	10,259
<i>Keora</i> ..	264,710	600	265,310	139,352	5,647	144,999
<i>Baen</i> ..	42,797	1,117	43,914	52,476	12,219	64,695
<i>Amur</i> ..	21,981	10	21,991	78,655	96	78,751
Other kinds ..	12,703	24	12,727	13,592	296	13,888
Total ..	3,251,596	7,907	3,259,503	1,926,570	78,135	2,004,705

NOTE.—The remarks made in paragraph 73 of Chapter II apply to these estimations also.

## CHAPTER IV.

THE SCHEME FOR WORKING CIRCLE III OR THE BASIRHAT  
WORKING CIRCLE.

## The General Composition and Analysis of the Crop.

90. **The composition of the crop.**—This working circle consists of all forests within the Basirhat Range, namely, the eastern part of the salt-water zone, whose crop and vegetation have been described in paragraphs 45 and 46 of Part I. The following statement gives a summary of the areas under each type of forest according to the stock maps:—

Type of forest.	Felling Series 1.	Felling Series 2.	Total.
<b>Third quality (20 feet to 35 feet height growth).</b>	Acres.	Acres.	Acres.
<i>Keora</i> .. .. .	507	..	507
<i>White baen</i> .. .. .	..	770	770
<i>Dhundal</i> and <i>kankra</i> , with understory of <i>goran</i> ..	..	1,681	1,681
Sparse standards of the following species over <i>goran</i> —			
<i>Sundri</i> and <i>gengwa</i> .. .. .	17,402	11,297	28,699
<i>Sundri</i> and <i>gengwa</i> mixed with <i>passur</i> or <i>dhundal</i> ..	12,491	784	13,275
<i>Gengwa</i> .. .. .	30,689	6,666	37,355
<i>Gengwa</i> mixed with either <i>passur</i> , <i>dhundal</i> , <i>kankra</i> , <i>baen</i> or <i>white baen</i> .. .. .	17,368	20,906	38,274
Total third quality forest ..	78,457	42,104	120,561
<b>Fourth quality (under 20 feet height growth).</b>			
<i>White baen</i> .. .. .	..	1,378	1,378
Sparse standards of the following species over <i>goran</i> —			
<i>Sundri</i> and <i>gengwa</i> .. .. .	1,252	7,706	8,958
<i>Sundri</i> and <i>gengwa</i> mixed with either <i>passur</i> , <i>dhundal</i> or <i>kankra</i> .. .. .	24,259	11,713	35,972
<i>Gengwa</i> .. .. .	42,965	42,823	85,788
<i>Gengwa</i> mixed with either <i>passur</i> , <i>dhundal</i> , <i>kankra</i> , <i>baen</i> or <i>white baen</i> .. .. .	51,552	106,912	158,464
<i>White baen</i> .. .. .	..	3,106	3,106
Total fourth quality forest ..	120,028	173,638	293,666
Recorded blanks or maidan ..	225	251	476
Total area ..	198,710	215,993	414,703

91. **Condition of the crop and types of produce available.**—There is a fair proportion of third quality forest within the circle, but most of it is very little above 20 feet in height growth. Practically the whole crop consists of sparse standards over *goran*; as the *goran* will be exploited under the prescriptions of Working Circle IV, the stocking of species with which this working circle deals, is very poor. *Gengwa* is the predominant standard, but most of the trees of this species are not capable of growing to timber size, and the timber which is available is of small dimensions and inferior in quality. Occasional standards of *sundri*, *passur*, *dhundal* and *kankra* occur among the *gengwa*; these are mostly of useful house-post size, and form the most valuable part of the crop. The few patches of *keora*, *baen* and *white baen* on new *chars* and along the banks of *khals* are also exploitable, and will yield a certain amount of timber; the poorer patches of *white baen* in drier localities can be exploited for fuel. Whichever

the soil is suitable for tree growth, there is no lack of regeneration; but owing partly to the extreme salinity of the water, and partly to the unsuitable management prescribed under the former plan, a considerable proportion of the crop consists of unsound stems, particularly in the cases of *sundri*, *dhundal* and *baen*. The enumeration results for stems of 3 inches in diameter and over of these three species, show a proportion of 36 per cent. unsound trees for *sundri*, 23 per cent. for *dhundal*, and 18 per cent. for *baen*. The *sundri* in this working circle has not been exploited at all for many years; many trees, therefore, have become unsound and are dying from over-age. The numerous unsound stems of *dhundal* and *baen* are the inevitable result of unrestricted and unregulated felling.

92. **Volume of the growing stock.**—The statements on the next page give the estimated volumes of timber and fuel per average acre in the two qualities of forest found within the working circle. The estimates have been calculated with the aid of the enumeration figures in item 20 of Appendix IX and the volume tables in Appendix V.

93. In addition to the volumes detailed on the the next page, it is estimated that the average volumes per acre for *keora* and *baen* of over 3 inches diameter for the whole working circle, are as follows:—

			Timber.	Fuel.	Total.
			C. ft.	C. ft.	C. ft.
<i>Keora</i>	..	..	4.27	2.90	7.17
<i>Baen</i>	..	..	1.44	3.62	5.06

The volume of *amur* of over 2 inches diameter has been included under the head other kinds in the estimation of the average volumes per acre in paragraph 92. This species is found only in Compartments Nos. 56 to 62 inclusive, in which the enumerations show an average of 3.96 stems of over 1 inch in diameter, or an estimated volume of .425 cubic feet per acre. The average volumes per acre in each diameter class, for *keora*, *baen* and *amur*, are given in Appendix IX.

#### Method of Treatment.

94. **The silvicultural system.**—The forest is too poor to justify much expense on detailed control. It is considered sufficient to divide the area up into annual coupes, within which, the fellings will be practically unregulated. The supervising staff will be employed mostly on seeing that each tree felled is as fully utilised as possible, and they will encourage the utilisation of unsound and defective stems whenever opportunity occurs.

95. **The felling cycle.**—In order to prevent the possibility of over-felling, a comparatively long felling cycle of 40 years is prescribed. Even with this period, the average sizes of the trees in the third quality forest, which are expected to be available for felling during the second 40-year felling cycle, will not be so large as the exploitable diameters prescribed in paragraph 39 of Chapter I; this applies particularly to *passur*, *dhundal* and *kankra* (*vide* the estimated rotations and corresponding diameters in paragraph 98). However, the greater portion of the forest is so poor that it would not be profitable to make the felling cycle still longer, and thus unduly increase the proportion of casualties. Moreover, the smaller sizes of poles are, at present, just as readily saleable as the larger sizes; also by allowing the export of fuel of all species under the coupe control prescribed, the probability is that the sale of fuel in this working circle will be more important than under the management of the former plan, during the currency of which, the export of fuel of most species had to be stopped in order to prevent excessive over-felling throughout the forests. The fellings prescribed on this 40-year cycle may be termed the "main fellings", in order to distinguish them from the additional fellings prescribed in the succeeding paragraph.

96. **Additional fellings of mature trees.**—When starting annual coupes with a fairly long felling cycle in forests which have not been previously worked on this system, there is bound to be a fairly large wastage during the first cycle, due to trees dying off from over-age. In order to reduce this wastage as much as possible, provision has been made for the felling of the more accessible mature and unsound trees in the *goran* coupes prescribed for Working Circle IV. It is not expected that very much will be removed in this way, but the probability is that the coupe officers will be able to mark and sell a few stems during their inspections of the *goran* cutting.

Third quality forest (volumes of apparently sound trees per acre).

(Reference para. 92.)

Diameter class.	Sundri.		Gengwa.		Passur.		Dhundal.		Kankra.		White baen.		*Other kinds.	
	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.
Inches.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
2 to 3	..	3.25	..	42.31	..	.26	..	.61	..	.14	..	.23	..	.63
3 " 4	..	2.20	..	32.11	..	.48	..	.34	..	.39	..	.85	..	.81
4 " 5	..	.45	14.24	9.49	.84	.20	.75	.13	.76	.23	..	1.04	.35	.57
5 " 6	..	.43	9.56	4.78	.81	.26	.50	.16	.48	.13	..	.67	.46	.41
6 " 7	..	.08	5.63	2.25	1.06	.46	.34	.20	.23	.07	.14	.28	.44	.44
7 " 8	..	.02	2.48	.87	.70	.35	.18	.18	.19	.07	.08	.11	.22	.22
8 " 9	..	.02	1.32	.46	.64	.31	.10	.17	.21	.09	.15	.19	.21	.21
9 " 10	..	.02	.35	.14	.20	.10	.08	.22	.08	.04	.02	.03	.18	.18
10 " 11	..	..	.33	.18	.21	.14	.04	.22	.08	.07	.02	.03	.05	.05
11 " 12	..	..	.05	.04	.16	.15	.11	.11	.05	.07	..	..	.03	.03
12 and over	..	..	.05	.04	.58	.53	.35	.35	.10	.16	..	..	.18	.18
Total	2.71	6.18	34.01	92.67	5.68	2.87	2.49	2.69	2.84	1.46	.41	3.43	2.14	3.73

Fourth quality forest (volumes of apparently sound trees per acre).

2 to 3	..	.88	..	21.87	..	.26	..	.95	..	.77	..	.58	..	.73
3 " 4	..	.84	..	18.26	..	.12	1.12	.41	..	.28	..	.71	..	1.41
4 " 5	..	.16	7.76	4.66	.47	.13	.78	.36	.49	.14	..	.43	.69	.87
5 " 6	..	.05	4.70	2.35	.54	.18	.40	.24	.34	.10	..	.36	.90	.56
6 " 7	..	.02	2.20	1.54	.58	.29	.27	.17	.24	.09	..	.25	.73	.46
7 " 8	..	.01	.89	.96	.22	.48	.15	.20	.13	.07	..	.07	.32	.27
8 " 9	..	.01	.38	.44	..	.53	..	.20	.05	.04	..	.07	.23	.26
9 " 10	..	.01	.11	.14	..	.18	..	.13	.02	.03	..	.01	.10	.15
10 " 11	..	..	.06	.07	..	.12	..	.09	.02	.09	..	.04	.05	.10
11 " 12	..	..	.04	.04	..	.07	..	.03	.01	.03	..	.02	.02	.06
12 and over	..	..	.01	.01	..	.21	..	.15	.01	.07	..	.01	.02	.07
Total	.40	1.98	16.15	50.34	2.14	2.57	2.72	2.93	1.87	1.71	..	2.55	3.07	4.94

NOTE.—The third quality forest in this working circle is of considerably inferior quality to the average of this quality class; also many patches of fourth quality forest, too small to stock map, are included in these enumeration figures. Consequently, the volumes of *sundri*, *gengwa*, *passur* and *kankra* have been calculated at rates about midway between that of average third quality forest, and the rates used for fourth quality forest in Working Circle I. The special volume table used is given beneath the enumeration results for this quality in Appendix IX. The volume tables of the other species have not been revised, because their exploitable diameters and rotations do not differ so much between the third and fourth quality classes.

\*The figures for "other kinds" do not include *keora* and *baen*, or the species which are to be worked under the prescriptions of Working Circle IV.

97. **Keora and baen.**—Even in the poor quality forests of this working circle, *keora* and *baen* grow to a fairly large size; consequently, with the system of unregulated felling prescribed, these species would be much over-felled. Provision has been made, therefore, for the marking of these two species before felling. Their marking and felling will be allowed both in the coupes of this working circle, and in those of Working Circle IV; in this way, they will be regularly felled over every 20 years, instead of every 40 years as with the main fellings of other species. Because of their size, and as they generally grow on or near the banks of the larger *khals*, *keora* and *baen* trees which are ready for felling are easy to locate, and their marking should not necessitate any extra staff.

98. **The rotations.**—With the system of unregulated fellings confined to annual coupes, it is estimated that on an average, all trees of 3 inches diameter and over will be cut. Very few trees of under this diameter are exploitable, and very few trees of over this diameter will be left when the coupe is finished. As the felling cycle chosen is 40 years, the average age of the trees exploited during the second felling cycle will be 20 years more than the age of the average tree of 3 inches diameter. As indicated in the preceding paragraph, selection fellings of *keora* and *baen* will be made on a 20-year cycle; their estimated rotations, therefore, will be 10 years more than the exploitable ages prescribed in paragraphs 41 and 42 of Chapter I. The rotations of the principal species under treatment prescribed have been estimated on these assumptions, and are given in the following statement. The diameters which correspond to these rotations, namely, the average diameter of the trees which are expected to be available for felling during the second felling cycle are also given:—

Species.	Third quality.			Fourth quality.		
	*Estimated age of average tree of 3 inches diameter.	Estimated rotation.	Corresponding diameter.	Estimated age of average tree of 3 inches diameter.	Estimated rotation.	Corresponding diameter.
	Years.	Years.	Inches.	Years.	Years.	Inches.
<i>Sundri</i> ..	68	88	4.0	100	120	3.6
<i>Gengwa</i> ..	49	69	4.4	68	88	4.1
<i>Passur</i> ..	47	67	4.4	59	79	4.1
<i>Dhundal</i> ..	59	79	4.1	68	88	4.0
<i>Kankra</i> ..	47	67	4.4	59	79	4.1
<i>White baen</i> ..	59	79	4.1	68	88	4.0

Average rotations for the whole circle:—

*Keora*, 85 years corresponding to 17.5 inches diameter.

*Baen*, 158 years corresponding to 13.9 inches diameter.

\*The third quality forest is inferior to the average third quality forest found within the division; this fact has been taken into account for these estimations.

99. **The allotment of the annual coupes.**—As already stated, the yield of poles from *sundri*, *passur*, *dhundal* and *kankra* form the most valuable produce in this working circle. The poles of these species are used mainly for the same purpose, namely, house-posts. Consequently, the annual coupes for the main fellings have been divided up with the idea of equalising the total joint outturn from these four trees. With unregulated felling, the total volume of timber in a coupe at the time of felling, represents the total possible yield. Except for *keora* and *baen*, the rotations estimated in the previous paragraph merely represent the estimated average age of the exploitable trees of each species which will be available in the main felling coupes of the second felling cycle, after the first cycle has been finished. For this reason, the formulas used for calculating the yields in Working Circles I and II, will be suitable only for *keora* and *baen* in this circle. The *sundri*, *passur* and *kankra* have been left unexploited since 1904 or 1905. Consequently, the increment of these species in areas waiting for felling will be largely counter-balanced by the casualties; the net increase in volume of exploitable material each year will not be more than about 1 per cent. of the present volume, which must be considered as above the normal one. *Dhundal* forms



about 30 per cent. of the total timber volume of the four species; unlike the others, it was over-felled during the currency of the last plan, and its present timber volume must be very much below normal. It will be quite safe, therefore, to estimate the annual increment of this species at 3 per cent. of the present timber volume. On this basis, it is estimated that the total timber volume of all four species in areas waiting for felling, will increase by about 1.6 per cent. of the present volume each year for the next 20 years. With regard to the coupes still waiting for main felling during the second 20 years of the felling cycle, it has been assumed that any increment during this period will be balanced by the removal of mature trees in the additional fellings during the first half of the cycle. On this assumption, and with the aid of the estimated total timber volumes of *sundri*, *passur*, *dhundal* and *kankra* in each compartment calculated in Appendix IX, it has been possible to allot the annual coupes for the main fellings in such a way that the estimated joint timber outturn from apparently sound trees of the four species will be about the same each year. As indicated in paragraph 96, the additional fellings of mature and unsound trees are of a subsidiary nature; this type of felling will be confined to the coupes prescribed for *goran* in sub-series (b) and (d) of Working Circle IV. The yields from these fellings will be small, and a certain amount of fluctuation each year in the possible yield from them will not matter.

100. For similar reasons to those given for Working Circle II in paragraph 84 of Chapter III, the prescriptions for the yield are by area; it will not be practicable to prescribe any check on the volume of the export.

#### Method of Executing the Fellings.

101. The following are the felling and coupe rules to be observed:—

(1) The fellings will consist of main fellings, and additional fellings of mature and unsound trees. Each type of felling will be confined to the coupes prescribed for the year, which will coincide with the *goran* coupes detailed for felling Series 6 and 7 of Working Circle IV (*vide* paragraph 102). For facility of control, the fellings within each of the annual coupes should be localised as far as possible and should gradually travel over the area allotted for the year.

(2) Purchasers will take out permits at revenue stations in the same way as under the former plan, but the permit will be for cutting only within the coupes prescribed. Permit-holders should be allowed a reasonable time for the journey from a station to a coupe; on arrival at a coupe, they will report to the coupe officer, who will allot them an area and allow them to commence cutting.

(3) With the exception of *keora* and *baen*, the main fellings will be unregulated. The principal work of the coupe officers will be to see that purchasers work within the area allotted to them, and that each tree felled is utilised to a reasonable extent.

(4) Additional fellings of over-mature and unsound trees will be allowed in the annual coupes as prescribed in paragraph 102. With the exception of *goran*, *math goran*, *singra*, *khalshi*, *kirpa* and *tora*, which are dealt with under the prescriptions of Working Circle IV, unregulated felling will not be allowed in these coupes. The fellings will consist merely of the removal of any mature and unsound trees, which the coupe officer is able to hammer-mark and sell whilst he is inspecting the *goran* cutting. The mature trees which he may mark in this way, will be any stem which has reached or exceeded the exploitable diameters detailed in paragraph 39 of Chapter I.

(5) Both in the main felling and in the additional felling coupes, trees of *keora* and *baen* should not be felled until the coupe officer, or his assistants if any, have hammer-marked them as silviculturally removable. These species seldom need thinning, and their treatment will consist of the removal of trees which have reached the exploitable diameters detailed in paragraph 40 of Chapter I, unsound and defective trees, and stems which should be removed under the provisions of marking rule (11) of Working Circle I. The timber and fuel of *white baen* is not distinguishable from *baen*. Consequently, in order to prove their identity, logs of *white baen* which are over 6 inches in diameter should be hammer-marked by the coupe staff *in situ* before the logs are removed from the forest. Care should also be taken that *baen* trees are not lopped for alleged *white baen* fuel.

(6) As far as possible, small local boats should be allowed to extract from the coupe which is most convenient for them. If the demand for any species is in excess of the exploitable material available in any coupe, boats of over 300 maunds in capacity should be sent to other coupes, and the produce should be reserved for smaller boats until the excess demand is worked off. Similarly, if extraction is in arrears, purchasers should be encouraged to come from other coupes.

(7) The definition of fuel given in the current schedule of royalty rates, namely, pieces under 3 feet maximum girth and 8 feet in length, is no longer applicable to many species. For this reason, fuel cutters should not be allowed in an area before the timber purchasers have taken all they need. After some experience of the extraction, it will probably be possible to fix the maximum fuel sizes for the most important species. As regards *amur*, which is utilised for timber purposes in very small sizes, no such distinction is practicable; the fuel of this species, therefore, should be sold at the rate fixed for poles.

#### Tabular Statement of Fellings to be made.

102. For the sake of convenience and economy, the coupes of this working circle have been made to coincide with the *goran* coupes detailed for Felling Series Nos. 6 and 7 of Working Circle IV. The main felling coupes have been prescribed with the idea of equalising the joint return of *sundri*, *passur*, *dhundal* and *kankra* according to the method indicated in paragraph 99. The details of the calculations which have been made to find out the acreages to be subjected to main fellings each year, will be found in item 25 of Appendix IX. The estimated possible yield of sound *sundri*, *passur*, *dhundal* and *kankra* timber from each year's main felling coupes is as follows:—

	C. ft.
Felling Series 1 .. .. .	46,955
Felling Series 2 .. .. .	68,463
Total .. .. .	115,418

As already stated the areas detailed for the additional fellings of mature and unsound trees, are those prescribed for sub-series (b) and (d) of Working Circle IV; the fellings for this working circle permitted within them, are of a subsidiary nature. The following statement details the areas to be felled over during the next 20 years:—

Year for which prescribed.	Main fellings.				Additional fellings of mature and unsound trees.			
	Felling Series 1.		Felling Series 2.		Felling Series 1.		Felling Series 2.	
	Com-partment No.	Area.	Com-partment No.	Area.	Com-partment No.	Area.	Com-partment No.	Area.
1931-32 ..	56	Acres. 5,191	67	4,318	61	6,914	64	11,590
1932-33 ..	56	5,109	67	4,250	61	6,392	64 57	5,231 3,708
1933-34 ..	56	5,030	67	4,184	61	5,921	57	6,725
1934-35 ..	56	4,953	67	4,121	61 62	2,956 2,331	57	6,387
1935-36 ..	56 59	3,596 1,771	67	4,059	62	4,210	57	6,078
1936-37 ..	59	6,633	67	3,998	62	2,570	57 70	4,250 2,397
1937-38 ..	59	6,537	67 66 (west)	3,505 436	62	2,301	70	8,529
1938-39 ..	59	6,443	66 (west)	3,887	62	2,058	70	7,690
1939-40 ..	59 58	2,035 3,326	66 (west)	3,832	62	3,619	70 69	5,392 1,747
1940-41 ..	58	4,826	66 (west)	3,779	62	4,220	69	6,270
1941-42 ..	58	4,760	66 (west)	3,727	62	3,998	69	6,011

[Continued on next page].

Year for which prescribed.	Main fellings.				Additional fellings of mature and unsound trees.			
	Felling Series 1.		Felling Series 2.		Felling Series 1.		Felling Series 2.	
	Compart-ment No.	Area.	Compart-ment No.	Area.	Compart-ment No.	Area.	Compart-ment No.	Area.
		Acres.				Acres.		Acres.
1942-43 ..	58	4,695	66 (west)		62	3,703	69	5,364
1943-44 ..	58	4,632	65		62	1,813	69	3,871
1944-45 ..	58	4,570	65	5,937	63	5,244	69	3,683
1945-46 ..	58	833	65	5,887	63	5,579	69	1,956
	60	4,810					68	2,633
1946-47 ..	60	5,823	65	5,812	63	5,468	68	5,673
1947-48 ..	60	5,749	65	5,313	63	5,238	68	5,361
1948-49 ..	60	5,676	64	5,035	63	5,023	68	
1949-50 ..	60	4,409		4,973	66 (east)	1,647	68	1,251
	61	1,017				3,560		
1950-51 ..	61	4,705		4,912	66 (east)	3,988	68	4,045
Total fellings for next 20 years.	..	107,129		92,679		91,581		123,314

NOTE—Compartment 66 (west) is the portion west of the Goasaba river, and Compartment 66 (east) is the portion east of that river.

### General Estimate of the possible Outturn from all Species

103. The following is an estimate of the future possible annual outturn from trees of all species and sizes within the working circles, under the treatment which has been prescribed:—

Species.	Estimated possible annual yields from all fellings.					
	Timber.			Fuel.		
	From sound trees.	From unsound trees.	Total.	From sound trees.	From unsound trees.	Total.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
<i>Sundri</i> ..	11,481	304	11,785	17,721	2,716	20,437
<i>Gengwa</i> ..	362,067	446	362,513	212,430	4,342	216,772
<i>Passur</i> ..	37,330	119	37,449	33,747	2,119	35,866
<i>Dhundal</i> ..	44,895	105	45,000	37,090	3,606	40,696
<i>Kankra</i> ..	37,627	21	37,648	19,251	226	19,477
<i>Keora</i> ..	52,731	186	52,917	29,493	1,823	31,316
<i>Baen</i> ..	9,279	258	9,537	17,563	3,626	21,189
<i>White baen</i> ..	2,224	4	2,228	25,244	261	25,505
<i>Amur</i> ..	192	..	192	498	..	498
Other kinds ..	43,888	8	43,896	41,705	107	41,812
Total ..	601,714	1,451	603,165	434,742	18,826	453,568

The methods used for calculating these estimates will be found in items 26 and 28 of Appendix IX.

## CHAPTER V.

THE SCHEME FOR WORKING CIRCLE IV OR THE GORAN  
WORKING CIRCLE.

## The General Character and Analysis of the Crop.

104. **Goran.**—This working circle consists of all the forests east of the Matla and Bidya rivers, excepting the areas in the northern portions of Sarankhola, Chandpai and Khulna Range. These areas have been excluded because they contain on an average less than 100 *goran* shoots of over 1 inch diameter per acre. (Vide paragraph 25 of Chapter I). The statement on the next page gives a summary of the distribution of the types of *goran* forest within the working circle, according to the stock maps.

105. *Goran* is a species of small coppice-like growth; but it is valuable for supplying small house-posts, fencing, fuel, tannin, etc. The forests which contain the most exploitable *goran* are the third quality forests. In the fourth quality forests, the *goran* is denser, but large stretches of useless scrub of about 4 feet to 6 feet in height occurs which, when felled over, will yield only brushwood. The best sticks are of from 14 feet to 16 feet height growth; this type is found mostly in the moister parts of poor second quality, or good third quality forest. Roughly, the forests east of the Raimangal and south of a diagonal line drawn from Koikhali Revenue Station to the mouth of the Supoti *khal*, are capable of yielding the best outturn of exploitable shoots per unit of area.

106. **Other species to be worked under the prescriptions of the Circle.**—The other species utilisable in small sizes, which will be exploited in the coupes of this working circle, are *singra*, *khalshi*, *kirpa*, *math goran* and *tora*. *Singra* is confined mostly to the fresh-water forests of Felling Series Nos. 1, 2 and 3; it is most prolific in the vicinity of the Baleswar river. If left to itself, *singra* will grow into a low, spreading and bushy tree; in suitable localities, it will attain a diameter of 12 inches or more; but its main economic importance is that, in small sizes, it supplies the most popular fuel obtainable in the Sundarbans. The exploitation of this species, therefore, has been included in the prescriptions for this working circle. *Tora* is a small species of *goran* like growth; it seldom exceeds 10 feet in height, and its wood is soft and spongy; there is very little demand for it, and it is not economically important. *Tora* occurs in patches, either near the sea-face, or in the salt-water forests; it is not very common. *Math goran* occurs only in Felling Series Nos. 6 and 7, west of the Raimangal river; in the younger stages, it is difficult to distinguish from ordinary *goran*; the main difference is that it grows to a somewhat larger size, and, as a rule, does not send out root-suckers. It is used extensively for small house-posts. *Khalshi* and *kirpa* are fairly evenly distributed throughout the working circle, though the latter is nowhere very abundant. Both species are used to some extent for house-posts and fuel.

## Distribution of types of goran forest.

(Reference paragraph 104.)

Type of forest.	Felling Series 1. Acres.	Felling Series 2. Acres.	Felling Series 3. Acres.	Felling Series 4. Acres.	Felling Series 5. Acres.	Felling Series 6. Acres.	Felling Series 7. Acres.	Total. Acres.
<b>First quality forests with little or no goran</b>	30,648	4,004	..	..	..	..	..	34,652
<b>Second quality forests—</b>								
With little or no goran	3,821	12,674	32,789	10,480	1,756	..	..	61,520
With understorey of goran	97,746	42,001	1,034	..	..	..	..	140,781
Total second quality	101,567	54,675	33,823	10,480	1,756	..	..	202,301
<b>Third quality forests—</b>								
With little or no goran	300	800	7,911	3,375	2,702	507	770	16,445
With understorey of goran	27,840	58,509	141,154	17,895	21,553	..	1,681	268,857
Goran under standards of other species.	..	12,348	41,721	75,150	57,803	..	..	187,022
Goran under sparse standards of other species.	..	755	..	14,989	40,089	77,950	39,653	173,436
Total third quality	28,230	72,412	190,680	111,409	122,462	78,457	42,104	645,760
<b>Fourth quality forests—</b>								
With little or no goran	..	..	..	..	143	..	..	1,521
Goran mixed with standards of other species.	..	1,727	..	..	..	..	..	1,727
Goran mixed with sparse standards of other species.	..	1,932	..	4,623	22,311	120,028	172,260	321,154
Total fourth quality	..	3,659	..	4,623	22,454	120,028	172,260	324,402
<b>Recorded blanks and maldan</b>	1,228	420	44	..	370	225	251	2,910
Total area	161,773	135,179	224,553	126,775	147,042	198,710	215,993	1,210,925

107. **Volume of the growing stock.**—In item 40, Appendix IX will be found the results of the enumerations of the six species with which this working circle is concerned. Converted into volumes per acre with the aid of the volume tables in Appendix V, the results may be summarised as follows:—

**Estimated average volumes per acre.**

Diameter class.	Goran.		Singra fuel only.	Khalshi.		Kirpa.		Math goran.		Tora fuel only.
	Poles and chittas.	Brush-wood.		Poles.	Fuel.	Poles.	Fuel.	Poles.	Brush-wood.	
Inches.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
<b>Forests in the Khulna district.</b>										
1 to 2	50.23	6.57	1.054	..	.335	..	.047	..	..	.025
2 "	46.56	..	.71	..	.33	.028	.007	..	..	.016
3 "	..	.12	.456	..	.07	.016	.008	..	..	.005
4 " 5	.01	.01	.233	.100	..	.002	.001	..	..	..
5 " 6	.00	.00	.143	.035	.012	.002	.001	..	..	..
6 and over	.00	.00	.448	.023	.018	.001	.001	..	..	..
Total	51.92	18.12	3.105	.158	1.091	.049	.065	..	..	.046

**Basirhat Range.**

1 to 2	50.52	15.16	.066	..	1.358	..	.061	..*	3.543*	1.489
2 " 3	2.66	.61	.051	..	.799	.078	.019	.967*	.240*	.143
3 " 4	.10	.03	.052	..	.204	.026	.013	.351*	.078*	.031
4 " 5	.01	.00	.021	.037	.022	.006	.003	.136*	.010*	.013
5 " 6	.00	.00	.009	.013	.004	.001	.001	.041*	..*	.006
6 and over	.00	.00	..	.004	.005	..	..	.024*	..*	.003
Total	53.29	15.80	.199	.054	2.392	.111	.097	1.519*	3.871*	1.685

\*Averages for the 312,139 acres only, in which this species is found. (See Appendix IX.)

NOTE.—In the forests of the Khulna district, the enumeration lines were made 1 mile apart, and in the Basirhat Range 1½ miles apart. If these two sets of enumerations were added together, they would not give a true average for the whole circle; consequently, the enumeration results for Basirhat Range have been kept separately.

10. The following statement illustrates the distribution of each species amongst the felling series :—

**Average total volumes of poles, fuel, brushwood, etc., per acre.**

Felling series number.	<i>Goran.</i>	<i>Singra.</i>	<i>Khalshi.</i>	<i>Kirpa.</i>	<i>Math goran.</i>	<i>Twa.</i>
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
Forests in the Khulna district.						
1	33.09	6.63	.17	.10		.073
2	53.04	3.22	.16	.31		.007
3	130.15	4.09	.49	.09		.003
4	89.48	.24	.37	.01		.001
5	74.13	.02	1.43	.07		.153
Basirhat Range.						
6	82.69	.25	2.66	.25	1	.797
7	56.68	.15	2.25	.18	8.09	.494

\*Averages for the 123,545 acres in Felling Series 6, and 185,594 acres in Felling Series 7, namely, only for the compartments in which this species is found.

### Method of Treatment.

109. **The Silvicultural system.**—The defects of the former system of management of uncontrolled fellings has been indicated in paragraph 105 of Part I. Despite the depletion which has occurred, there is still sufficient *goran* for the perpetual supply of present markets. *Goran* growth is more in the nature of coppice than anything else; but it differs from coppice in that new shoots generally appear as root-suckers and do not sprout from the stool. Most of the new growth found in the forests are root-suckers which often spring up some distance away from the parent root. In order to get at the most exploitable sticks in the centre of a bunch, woodcutters have been in the habit of stripping off the young withes as well. That this practice has been the cause of the death of a considerable number of root-stocks is illustrated by the two experimental plots in *Kopanchia gang*. (See paragraph 123 of Part I.)

110. The system prescribed for *goran* is therefore as follows :—

- (1) The fellings will be confined to annual coupes, with a felling cycle most suitable to its rate of growth.
- (2) The fellings will be supervised in order to ensure that young withes are left on the roots and are not needlessly cut.

The first prescription will ensure the greatest possible outturn, and prevent continual overcutting in favoured areas; the second will ensure the regeneration of the crop.

111. **The felling cycle.**—The only information regarding the rate of growth of *goran* was obtained from a remeasurement in August 1928, of Sample Plots Nos. 10, 12 and 113 and Experimental Plot No. 2, laid out by the Silviculturist in March 1926. The results of measurement after such a short period, and in the middle of the growing season, cannot be considered reliable; neither do the points obtained for diameter increment conform to a good curve. The measurements and calculations are given in detail in Appendix IV; the diameter increment curve which is the nearest approximation to the results obtained, is as follows :—

Diameter											
at 3 feet	..	$\frac{1}{4}$ "	$\frac{1}{2}$ "	$\frac{3}{4}$ "	1"	1 $\frac{1}{4}$ "	1 $\frac{1}{2}$ "	1 $\frac{3}{4}$ "	2"	2 $\frac{1}{4}$ "	2 $\frac{1}{2}$ "
Age in years	..	5.0	8.6	12.0	15.5	19.1	22.8	26.8	31.3	37.5	50.0

The percentage of deaths appears to increase above 2 inches diameter; this fact, together with the shape of the curve, indicates that the average maximum diameter is about  $2\frac{1}{2}$  inches. The experimental plot in *Kopanchia gang* was treated in a similar fashion to that prescribed in Felling Rule (1) (b) of paragraph 117, and is growing much more vigorously than the plots which have not been treated in this way. Consequently for the purpose of this plan, the rate of growth indicated in the curve is unlikely to be an over-estimate.

112. The usual sizes of sticks exploited are from  $1\frac{1}{4}$  inches to  $2\frac{1}{4}$  inches in diameter; according to the estimated diameter increment curve, it takes 18.4 years for *goran* to grow through these limits. Sticks of over 2 inches in diameter are comparatively rare, and the proportion of deaths is considerable. (See item 7 of Appendix IV.) It will not be profitable, therefore, to unduly lengthen the rotation for the production of  $2\frac{1}{4}$  inches sticks. Accordingly, a felling cycle of 16 years is prescribed, without any restrictions regarding the sizes of sticks which may be exploited. In half this period, namely, 8 years, the average stick of  $1\frac{1}{4}$  inches in diameter will grow to slightly over  $1\frac{3}{4}$  inches in diameter. Thus, this treatment should tend in time to make  $1\frac{3}{4}$  inches the diameter of the average stick exploited, but stems of over 2 inches will be comparatively rare. Purchasers needing larger poles may work in the better quality forests, where the *goran* is too scattered to include in this working circle, and is exploited with the main timber species on a longer felling cycle; at the same time, the embargo against the cutting of single stems of under 2 inches diameter in Felling Rule (1) (b) of paragraph 117, will ensure the supply of a certain number of large poles within this working circle.

113. The *goran* sample plots measured for obtaining the rate of growth are all situated in third quality forest. Felling Series Nos. 6 and 7 contain mostly fourth quality forest, where, in all probability, the rate of growth of *goran* is somewhat slower; there is also a considerable proportion of *math goran*, which most likely requires a somewhat longer rotation than the ordinary variety. For these reasons, it has been considered advisable to lengthen the felling cycle in these two felling series to 20 years. As the other prescriptions for these series will be identical with those of Felling Series Nos. 1 to 5, it has not been thought necessary to constitute them into a separate working circle.

114. **The allotment of the annual coupes.**—The annual coupes have been divided up with the idea of equalising the outturn of the *goran*. In item 30 of Appendix IX, an estimate has been made of the total volume of *goran* poles and *chittas* in each compartment. The yield of a coupe may be taken to be proportional to the volume of poles and *chittas* within it; consequently, by using these figures in Appendix IX, it has been possible to divide up the annual coupes into areas which have equal estimated volumes or yields. But these estimated volumes must be equal volumes at the time of felling. As the felling of *goran* has not previously been confined to coupes, the present estimated volumes of the coupes prescribed at the beginning of the first felling cycle must be larger than the present estimated volumes of the coupes detailed for felling towards the end of the cycle.

115. Nothing is known regarding the increase to be expected in the volume of exploitable material in a *goran* crop, if left to itself for a period of 16 or 20 years, namely, the length of the two felling cycles chosen. However, in the average forest of the first five felling series, it will be seen from the figures in paragraph 111, that *goran* grows at the rate of about 1 inch in diameter in 16 years up to the size of 2 inches in diameter. In the present growing stock, the bulk of the volume of shoots of 1 inch in diameter and over, consists of that of the lowest diameter class, namely, 1 inch to 2 inches. Therefore, it may safely be assumed that, if the *goran* were left to itself, the volume of shoots of 1 inch in diameter and over would double itself in a period of 16 years. This period is also the felling cycle; consequently, for the inferior forests of Felling Series Nos. 6 and 7, it may be assumed in a similar way that the shoots of 1 inch in diameter and over will double their volume if left uncut during the period of the felling cycle prescribed for these forests, namely, 20 years. On these assumptions, it may be deduced that, whilst waiting for felling during the first felling cycle, the volumes in the coupes of Felling Series Nos. 1 to 5 inclusive, will increase at the rate of one-sixteenth of their present volume per year, and the volumes in the coupes of Felling Series Nos. 6 and 7 will



increase at the rate of one-twentieth of their present volume per year. The coupes prescribed have been divided up according to these deductions, the expected volumes at the time of felling of each annual coupe in a felling series, being always the same. The details of the calculations used will be found in item 36 of Appendix IX. The coupes to be prescribed for the second felling cycle for Felling Series Nos. 1 to 5, present no difficulty. The areas will have been felled either 16 or 17 years previously; consequently, the possible yields should be roughly proportional to the present volumes.

116. The next species in importance to *goran*, namely, *singra*, occurs in quantity only in localities where *goran* is comparatively scarce, and thus does not tend to give an even yield from coupes arranged solely to equalise the outturn of *goran*. But about half the *singra* crop in the division is to be found in the northern part of the Sarankhola, Chandpai and Khulna Ranges, where it will be worked under the prescriptions of Working Circle I; it has therefore been possible to arrange the fellings in Working Circles Nos. I and IV in such way that their joint possible outturn of *singra* will be fairly even each year. With seven felling series, it is not expected that the possible outturn of other species will vary very much from year to year, except in the case of *math goran* whose *habitat* is confined to the Basirhat Range. As this species is used for exactly the same purposes as the larger poles of *goran* or the smaller poles of other *Rhizophora*s, an unequal supply of it will not hamper trade in any way.

### Method of Executing the Fellings.

117. The following are the felling rules to be observed and the coupe rules which indicate how the fellings should be managed and supervised:—

#### FELLING RULES.

(1) GORAN.—(a) Ordinarily, the fellings should be confined to the areas prescribed for the year. If, owing to lack of demand, the *goran* fellings in any series should fall into arrears to the extent of more than two annual coupes, the years in which subsequent fellings in that series have been prescribed, should be revised, in order that the coupes will have at least 14 years to recover, before the fellings of the next cycle become due. On the other hand, should the demand in any felling series exceed the supply, the fellings should not be allowed to become more than one year in advance.

(b) At least one *goran* shoot, preferably more, should be left on each root or bunch. Except where absolutely unavoidable, woodcutters should not be allowed to cut young withes merely to facilitate felling, and not for actual utilisation. Solitary stems of under 2 inches in diameter at 3 feet from the base, should be left to produce either a larger pole or a larger root and more-shoots.

(2) OTHER SPECIES.—Felling of *singra*, *khalshi*, *kirpa*, *math goran* and *tora* will be allowed within the annual coupes being worked for *goran* during the year. Purchasers should not be allowed to cut sound or unsound stems of *singra* of over 6 inches in diameter. Such stems should be pollarded, in order that they may produce more sticks for fuel during the next felling cycle. In the years 1935-36 and 1944-45, considerably more *singra* will be available for felling in the coupes as prescribed, than in other years. For this reason, the felling of *singra* in Compartments Nos. 1, 16 and 39 may be started one or two years before the year prescribed, or be continued one or two years after the prescribed year if the demand should necessitate this procedure. An extra *singra* coupe required for this purpose would only need one forester for its supervision. The felling rules of *goran* will also apply to *math goran*. *Math goran* grows as a rule in single stems and not in bunches; consequently, the rule regarding the cutting of solitary stems of *goran* will prevent this species from being overcut. No other regulations are required for the felling of these other species.

(3) REMOVAL OF UNSOUND STEMS OF SPECIES BELONGING TO OTHER WORKING CIRCLES.—Whenever the demand and staff for the extra supervision is available, unsound stems, or trees falling into rivers and *khals*, of species other than those mentioned in rule (2), may be sold on these coupes. Much wastage from casualties in species such as *sundri*, *passur*, etc., may be avoided in this way. In Felling Series Nos. 6 and 7,

the coupes of this working circle will coincide with the main felling and additional felling coupes of Working Circle III, and will be supervised by the same coupe officer. (Vide paragraph 102 of Chapter IV.)

#### COUPE RULES.

(1) The produce available will be sold on royalty rates. Except for the purposes of felling rule (3), marking before felling is neither practicable nor necessary; the coupe officer and his forest guards will supervise the cutting and extraction, and see that the few felling rules are obeyed.

(2) Although the fellings in each series will proceed simultaneously, the extraction within each coupe should be localised as far as possible; that is to say, purchasers should not be allowed to cut anywhere they choose within the annual coupe, but only in the particular section or *khal* allotted to them. The coupes for the year should be divided up roughly into sections of convenient size, using natural boundaries wherever possible. Two or three of the purchasers' boats should be allowed to work in each section until it is finished; after which, a fresh section may be allotted to them if they are not already fully loaded. Providing the sections are made sufficiently small, the work can be localised in this way, and the fellings will gradually travel over the area prescribed for the year. The work should proceed systematically over a section, in order that no purchaser gets the pick of the produce and leaves the inferior stuff for others to exploit. As far as possible, the fellings of *singra*, *khalsi*, etc., should be made together with the *goran*, or at any rate near enough to be under the effective control of the coupe staff. In thick forests where the formation of extraction paths are necessary, the coupe officer will choose their alignment with the aid of the experience of the *goran* cutters, and have them cleared with the help of their labour.

(3) *Goran* purchasers, who have paid royalty at the pole rate, should be allowed to cut over an area first of all; after which, purchasers on fuel rates may be allowed to remove crooked and defective sticks. *Goran* fuel purchasers should not be allowed to take stick of more than 4 feet in length.

(4) Should a coupe finish its prescribed area before the end of the year, felling by small local boats may be permitted in the next year's area, but all large boats should be sent to a coupe in another felling series, where the demand has not been so large. If all the coupes finish before their time in this way, the Divisional Forest Officer will be guided by rule (1) (a) of the felling rules. If the excess demand continues until the next year's coupes have been exploited, the number of permits should be limited, or the royalty rate raised, until the equilibrium between the supply and demand is regained.

(5) Large areas of scrub *goran* of under 10 feet height growth need not be exploited at all, unless the fellings are in advance or there is a demand for this type of produce. Very little control need be exercised over such fellings, unless the exploitation of this type of forest becomes extensive. *Goran* in these areas may be sold at reduced rates.

(6) Owing to the difficulty of distinguishing between the two species, *goran* and *math goran*, they should be classed as one for the purpose of fixing the royalty rates, for the issue of permits and for recording the outturn.

(7) For the purpose of control, only the export of *goran* (including *math goran*), *singra*, *khalsi*, *kirpa* and *tora* should be recorded as the outturn of this working circle. The export of other species, such as timber and fuel removed under felling rule (3), or trees cut for *jhools*, masts, *mallums*, etc., should be recorded as the outturn of the particular working circle to which they belong. When a coupe is working within the area of Working Circle I, the coupe officer will record the diameter and quality class of any *sundri*, *gengwa* and *passur* trees of 6 inches in diameter and over, which are felled and which appear to be sound before felling. (Vide paragraph 12 of Appendix XI.)

#### Tabular Statement of Fellings to be made.

118. As indicated in paragraphs 114 and 115, the annual coupes are prescribed with the idea of equalising the possible outturn of *goran* from each felling series. The present volume of *goran* poles and *chittas* in each coupe is given in item 36

of Appendix IX. In the Basirhat Range, the two felling series have been divided into four Sub-series, namely, (a), (b), (c) and (d), in order that the coupes of this working circle will coincide with those of Working Circle III. (Vide paragraph 102 of Chapter IV.) The coupes of Sub-series (a) and (c) have been prescribed according to the needs of Working Circle III, and the coupes in Sub-series (b) and (d) have been divided up with the idea of equalising the joint outturn of *goran* from each pair of annual coupes in the two main Felling Series Nos. 6 and 7. The following statement details the areas which are to be felled over during the next 20 years:—

### Forests in the Khuina District.

Year for which prescribed.	Coupes to be opened for fellings.									
	Felling Series 1.		Felling Series 2.		Felling Series 3.		Felling Series 4.		Felling Series 5.	
	Com-part-ment No.	Area.	Com-part-ment No.	Area.	Com-part-ment No.	Area.	Com-part-ment No.	Area.	Com-part-ment No.	Area.
	Acres.		Acres.		Acres.		Acres.		Acres.	
<b>The first felling cycle.</b>										
1931-32	13 12 (east) 3	13,622 8,934 6,436	8	10,598	43	9,927	50 (east) 51 (east)	4,728 6,530	51 (west)	9,825
1932-33	3 4	7,417 7,218	8	9,993	43 44	1,873 7,541	51 (east) 52	2,511 6,248	51 (west) 55	5,795 3,770
1933-34	4 5	8,050 3,629	8	9,453	44	8,918	52	7,957	55	9,522
1934-35	5 6	8,723 2,351	8 9	2,684 5,562	44	8,461	52	7,549	55	9,034
1935-36	6	6,514	9	7,550	39 16 17	15,499 15,607 14,011	52	7,180	55	8,593
1936-37	6	6,211	9	7,199	17 18	6,189 9,334	52 53	565 6,691	55	8,194
1937-38	6 7	2,840 3,198	9	6,879	18	13,607	53	6,969	55 49	3,325 5,631
1938-39	7	5,870	9 45	4,746 1,681	18 19	8,418 5,584	53	6,673	49	9,371
1939-40	7	5,631	45	5,771	19 20	14,145 1,832	53 54	376 4,875	49	8,988
1940-41	7	5,410	45	5,545	20 38 41	17,271 16,357 5,771	54	4,976	49 48	4,826 3,249
1941-42	7	5,206	45	5,336	41 42	12,475 2,751	54	4,788	48	7,087
Carried over		107,260		82,997		195,571		78,616		97,210

Year for which prescribed.	Coupeš to be opened for fellings.									
	Felling Series 1.		Felling Series 2.		Felling Series 3.		Felling Series 4.		Felling Series 5.	
	Com-part-ment No.	Area.	Com-part-ment No.	Area.	Com-part-ment No.	Area.	Com-part-ment No.	Area.	Com-part-ment No.	Area.
		Acres.		Acres.		Acres.		Acres.		Acres.
	<b>The first felling cycle.— concluded.</b>									
Brought forward		107,260		82,997		195,571		78,616		97,210
1942-43	7 11	2,558 4,516	45	5,141	42	6,430	54	4,614	48	6,829
1943-44	11	8,893	45 15	3,762 6,821	42	6,204	54	4,452	48 47	2,984 10,968
1944-45	11 1	133 15,366	15 14 12 (west)	6,540 9,949 3,826	42 43	3,074 2,704	54	4,302	47 50 (west)	14,308 1,778
1945-46	1 2	9,729 3,577	12 (west) 10	1,347 6,959	43	5,370	54	4,161	50 (west)	6,587
1946-47	2	9,741	10	7,837	43	5,200	54 46	2,639 27,991	50 (west)	6,378
Total area		161,773		135,179		224,553		126,775		147,042
	<b>The second felling cycle.</b>									
1947-48	13 12 (east) 3	13,622 8,934 397	8	7,575	43	7,094	50 (east) 51 (east)	4,728 3,576	51 (west)	7,022
1948-49	3 4	13,456 962	8	7,574	43 44	4,706 2,407	51 (east) 52	5,465 1,667	51 (west)	7,022
1949-50	4	8,707	8	7,575	44	7,146	52	6,376	51 (west) 55	1,576 5,918
1950-51	4 5	5,599 4,005	8	7,574	44	7,146	52	6,376	55	7,630
Total area to be felled in first four years of the second felling cycle		55,682		30,298		28,499		28,188		29,168

## Basirhat Range.

Year for which prescribed.	Coupes to be opened for fellings.							
	Felling Series 6.				Felling Series 7.			
	Sub-series (a).		Sub-series (b).		Sub-series (c).		Sub-series (d).	
	Compartment No.	Area.	Compartment No.	Area.	Compartment No.	Area.	Compartment No.	Area.
	Acres.		Acres.		Acres.		Acres.	
1931-32	56	5,191	61	6,914	67	4,318	64	11,590
1932-33	56	5,109	61	6,392	67	4,250	64 57	5,231 3,708
1933-34	56	5,030	61	5,921	67	4,184	57	6,725
1934-35	56	4,953	61 62	2,956 2,331	67	4,121	57	6,387
1935-36	56 59	3,596 1,771	62	4,210	67	4,059	57	6,078
1936-37	59	6,633	62	2,570	67	3,998	57 70	4,250 2,397
1937-38	59	6,537	62	2,301	67 66 (west)	3,505 436	70	8,529
1938-39	59	6,443	62	2,058	66 (west)	3,887	70	7,690
1939-40	59 58	2,035 3,326	62	3,619	66 (west)	3,832	70 69	5,392 1,747
1940-41	58	4,826	62	4,220	66 (west)	3,779	69	6,270
1941-42	58	4,760	62	3,998	66 (west)	3,727	69	6,011
1942-43	58	4,695	62	3,793	66 (west) 65	2,795 1,468	69	5,364
1943-44	58	4,632	62 63	1,813 2,738	65	6,046	69	3,871
1944-45	58	4,570	63	5,244	65	5,965	69	3,683
1945-46	58 60	833 4,810	63	5,579	65	5,887	69 68	1,956 2,633
1946-47	60	5,823	63	5,468	65	5,812	68	5,673
1947-48	60	5,749	63	5,238	65 64	5,313 377	68	5,361
1948-49	60	5,676	63	5,023	64	5,035	68	4,472
1949-50	60 61	4,409 1,017	63 66 (east)	1,647 3,560	64	4,973	68	4,251
1950-51	61	4,705	66 (east)	3,988	64	4,912	68	4,045
Total area		107,129		91,581		92,679		123,314

NOTE.—Compartments which are denoted "east" and "west," are compartments which are situated partly in one felling series and partly in another.

### Estimate of the possible Annual Outturn under the Treatment Prescribed.

119. The following are the possible annual yields from each species during the first felling cycle, estimated according to the methods indicated in items 37 and 39 of Appendix IX :—

Species.	Estimated possible annual yields under the treatment prescribed.	
	Poles and <i>chittas</i> .	Fuel and brushwood.
	C. ft.	C. ft.
Goran .. .. .	4,013,433	1,176,189
Math goran .. .. .	30,823	6,675
Singra .. .. .	..	128,929
Khalshi .. .. .	11,176	74,427
Kirpa .. .. .	6,001	2,085
Tora .. .. .	..	35,693
<b>Total for all species</b> .. .. .	<b>4,061,433</b>	<b>1,423,998</b>

NOTE.—The possible yields from unsound stems in this working circle are very small; they have been included in the above estimates.

Handwritten notes and calculations:

20000

75 ~~1176189~~ 1176189

3000/48

75 wice

30 58 30

## CHAPTER VI.

THE SCHEME FOR WORKING CIRCLE V OR THE WESTERN  
WORKING CIRCLE.

## The General Composition and Analysis of the Crop.

120. **The composition of the crop.**—This working circle is comprised of the whole of Namkhana Range, namely, the Protected Forests west of the Matla and Bidya rivers. The crop is described in paragraph 47 of Part I; it consists mostly of poor fourth quality forest and scrub, interspersed with large stretches of *hantal*; from the Saptamukhi westwards, the quality improves somewhat, and patches of fair quality *keora*, *baen* and *white baen* growing on the new *chars* are frequently met with. The following statement gives the areas under different types of forest according to the stock maps :—

Type of Forest.	Felling Series 1.	Felling Series 2.	Total.
<b>Third quality (20 feet to 35 feet height growth).</b>	Acres.	Acres.	Acres.
<i>Keora, baen and white baen</i> .. .. .	..	2,038	2,038
<i>White baen</i> .. .. .	621	3,134	3,755
<i>Gengwa</i> mixed with a small proportion of <i>sundri</i> , <i>passur</i> and <i>baen</i> , with under-story of <i>goran</i> .. .. .	..	1,888	1,888
Sparse standards of <i>gengwa</i> and <i>white baen</i> over <i>goran</i> .. .. .	344	..	344
Large stretches of <i>hantal</i> , interspersed with the following species :—			
<i>Sundri, gengwa and goran</i> .. .. .	..	2,930	2,930
<i>Gengwa and goran</i> .. .. .	..	10,530	10,530
<b>Total, third quality forest</b> .. .. .	<b>965</b>	<b>20,520</b>	<b>21,485</b>

Type of Forests.	Felling Series 1.	Felling Series 2.	Total.
	Acres.	Acres.	Acres.
<b>Fourth quality (under 20 feet height growth).</b>			
<i>Gengwa</i> and <i>white baen</i> .. .. .	..	2,271	2,271
<i>White baen</i> .. .. .	3,914	3,150	7,064
Sparse standards of the following species over <i>goran</i> :—			
<i>Sundri</i> and <i>gengwa</i> .. .. .	647	..	647
<i>Sundri</i> , <i>gengwa</i> and <i>dhundal</i> .. .. .	4,832	..	4,832
<i>Gengwa</i> .. .. .	23,287	..	23,287
<i>Gengwa</i> mixed with either <i>passur</i> , <i>dhundal</i> , <i>kankra</i> , <i>baen</i> or <i>white baen</i> .. .. .	52,002	..	52,002
<i>White baen</i> .. .. .	366	..	366
Large stretches of <i>hantal</i> interspersed with the following species :—			
<i>Sundri</i> , <i>gengwa</i> and <i>goran</i> .. .. .	..	4,389	4,389
<i>Gengwa</i> and <i>goran</i> .. .. .	32,396	5,321	37,717
Total, fourth quality forests .. .. .	117,444	15,131	132,575
<b>Recorded blanks or maidan</b> .. .. .	211	538	749
Total area .. .. .	118,620	36,189	154,809

121. **The types of produce available.**—Generally speaking, the forests are very sparsely stocked with exploitable material. Stunted *gengwa*, small sized *goran*, *math goran*, *white baen* and *hantal* are the most common species. During the currency of the former plan, the main exports were *goran chittas*, *white baen* fuel, *math goran*, *dhundal* and *goria* poles, *gengwa* and other kinds of fuel, and *hantal* stems. As in other western forests, the export of *sundri*, *passur*, *kankra* and *keora* has been stopped since about 1904, excepting for a limited export during recent years, which has been allowed in the parts of Compartment 75 under process of colonization; consequently, there is also a limited supply of trees of these species suitable for felling.



122. **Volume of the growing stock.**—The results of the enumerations may be found in Appendix IX; these results have been converted into estimated volumes per acre, in the same way as has been done for the other working circles.

(a) SPECIES WHOSE AVERAGE VOLUME HAS BEEN CALCULATED SEPARATELY FOR EACH QUALITY CLASS.—

**Third quality forest (volumes of apparently sound trees per acre).**

Diameter class in inches.	Sundri.		Gengwa.		Passur.		Dhundal.		Kankra.		White baen.		Singra.		*Other kinds.		
	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel only.	Timber.	Fuel.	
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
2 to 3	..	1.68	..	10.00	..	.20	..	.20	..	.06	..	31.12	..	.09	..	1.07	..
3 ,, 4	..	1.73	..	9.49	.42	.10	.15	.22	..	..	..	27.54	..	.31	..	3.48	..
4 ,, 5	..	3.57	1.82	4.27	.18	.04	.03	.19	.10	.03	..	18.83	..	.24	1.78	2.85	..
5 ,, 6	..	4.51	1.52	5.15	.36	.11	.07	.24	..	..	..	8.74	..	.16	1.58	1.42	..
6 ,, 7	..	4.75	1.52	3.41	.16	.07	.08	.14	..	..	..	1.19	.59	..	.77	.77	..
7 ,, 8	..	1.84	.59	1.58	..	..	..	..	..	..	..	.28	.21	..	.30	.30	..
8 ,, 9	..	.39	.14	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9 ,, 10	..	.45	.28	.65	.26	..	..	..	..	..	..	..	..	..	..	..	..
10 ,, 11	..	.49	.40	.40	.22	..	..	..	..	..	..	..	..	..	..	..	..
11 ,, 12	..	..	..	.87	.67	.54	..	..	..	..	..	..	..	..	..	..	..
12, and over	..	..	..	..	.54	.49	..	..	..	..	..	..	..	..	..	..	..
Total	17.73	11.76	16.33	27.98	2.20	1.51	.79	.53	.10	.09	.80	87.71	.80	.80	5.23	10.69	..

NOTE.—The volumes of third quality *sundri*, *gengwa*, *passur* and *kankra* in this working circle, have been calculated with the aid of the same volume table as that used for these species in Working Circle III, and for the same reasons. (Vide note for third quality forest, in paragraph 92 of Chapter IV.)  
\*Other kinds in this working circle consist mainly of *garjan*, *ora* and *Lan-takal*.

## Fourth quality forest (volumes of apparently sound trees per acre).

Diameter class in inches.	Sundri.		Gengwa.		Passur.		Dhundal.		Kankra.		White baen.		*Other kinds.		
	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Timber.	Fuel.	Fuel only.	Timber.	Fuel.	Timber.	Fuel.
2 to 3	..	.20	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
3, 4	..	.29	..	10.96	..	.19	..	.23	..	.50	1.91	..	.51	..	.68
4, 5	..	.04	..	9.38	.20	.07	.32	.11	.36	.18	1.88	..	.36	..	.20
5, 6	..	.01	4.77	2.86	.42	.12	.29	.13	.33	.09	1.18	.29	.36	.29	.13
6, 7	..	..	3.34	1.67	.33	.11	.29	.18	.19	.06	.71	.33	.20	.33	.13
7, 8	..	..	1.50	1.05	.39	.19	.13	.08	.17	.07	.60	.19	.12	.14	.08
8, 9	..	..	.67	.73	.08	.17	.09	.12	.09	.04	.19	.14	.12	.07	.04
9, 10	..	..	.22	.25	..	.19	..	.14	.16	.12	.06	.07	.08	.03	.04
10, 11	..	..	.14	.17	..	.10	..	.04	.05	.07	.11	.03	.04	.02	.05
11, 12	..	..	.07	.08	..	.07	..	.04	.02	.09	..	.02	.04	.02	.11
12, and over	..	..	.01	.01	..	.09	..	.06	.06	.28	..	.03	.11	.03	.11
Total	.10	.54	10.72	27.16	1.42	1.37	1.12	1.19	1.43	1.50	6.64	1.12	2.32	1.12	2.32

\*Other kinds in this working circle consist mainly of garjan, ora and tan-bakul.

(b) SPECIES WHOSE AVERAGE VOLUME HAS NOT BEEN CALCULATED SEPARATELY FOR EACH QUALITY OF FOREST.—In addition to the volumes detailed in the foregoing statements, the following are the estimated average volumes of species, whose estimated volumes per tree are the same in both qualities of forest found within the working circle:—

**Average volumes per acre throughout the working circle.**

Diameter class in inches.	Keora.		Baen.		Goran.		Math goran.		Kirpa.		Khalshi.		Tora.
	Timber. C. ft.	Fuel. C. ft.	Timber. C. ft.	Fuel. C. ft.	Poles and chittas. C. ft.	Brush- wood. C. ft.	Timber. C. ft.	Fuel. C. ft.	Poles. C. ft.	Fuel. C. ft.	Poles. C. ft.	Fuel. C. ft.	Fuel only. C. ft.
1 to 2	*	*	*	*	16.00	4.80		8.78		.03			2.33
2 ,, 3	..	.01	..	.31	.97	.22	2.99	.74	.09	.02	..	.74	.32
3 ,, 4	..	.02	..	.35	.07	.02	1.22	.27	.05	.02	..	.07	.08
4 ,, 5	..	.08	..	.45	.01	.01	.38	.03	.02	.02	..	.03	.01
5 ,, 6	..	.06	..	.80	..	..	.10	..	.01	.00	..	.01	..
6 ,, 9	..	.09	.39	1.51	..	..	.03	.00	..	..	..	..	..
9 ,, 12	..	.01	.42	.89	..	..	.01	.00	..	..	..	..	..
12, and over	..	..	.13	.14	..	..	..	..	..	..	..	..	..
Total	.20	.27	.94	4.45	17.05	5.05	4.73	9.82	.17	.09	.04	1.05	2.74

\* The volumes of keora and baen saplings of 1 inch to 2 inches in diameter have not been estimated.

### Method of Treatment.

123. **The system of management.**—The forests of this working circle are protected only, and not reserved; they consist mostly of poorly stocked fourth quality forests, in which it is estimated that the average *gengwa* tree attains a diameter of 4 inches at breast height in 86 years, and other species show correspondingly slow rates of growth. With such slow growth and such poorly stocked areas, it is obvious that any sort of detailed control would not be an economical proposition. Accordingly, these forests will be worked on the revenue station and permit system as before. There will be no coupe control as in Working Circle III, and unregulated felling by purchasers with small boats will be allowed throughout the working circle; but in order to conserve the crop to a certain extent, felling by purchasers with large boats will be restricted to certain areas.

124. **Felling for export by large boats.**—Compartment No. 75 consists of odd plots and islands, most of which Government intends to disforest and colonize during the next 40 or 50 years. Consequently, this compartment has been made into a separate felling series, namely, Felling Series No. 2, in which the felling by purchasers with large boats will be concentrated on the areas which are in process of, or are about to be colonized. The remaining four compartments, namely, Compartments Nos. 71, 72, 73 and 74, constitute Felling Series No. 1. For purchasers with large boats, each of these compartments, in turn, will be open to felling for a period of years proportional to the total volume of timber and fuel of all species available within the compartment, as estimated in item 41 of Appendix IX. The sum total of these periods, namely, the felling cycle, has been fixed at 40 years. This is the same cycle as that fixed for Working Circle III, and it has been chosen as suitable for most species for similar reasons. With regulated felling, this period would be too long for *goran* which is exploited in smaller sizes than are the other species; but with unregulated felling, and export by smaller boats from the areas closed to the large boats, the crop will take much longer to recover. It is considered, therefore, that a 40-year cycle will also be fairly suitable for *goran*. According to the method indicated, the different periods for which the compartments should remain open to extraction by large boats during the felling cycle, are given in the following statement:—

Compartment No.	Estimated total volume of timber and fuel in the present growing stock. C. ft.	Period for which the area should remain open to large boats. Years.
71	1,566,636	5
72	2,487,855	8
73	4,102,550	13
74	4,396,681	14
Total	12,553,722	40

125. **Other regulations.**—In order to prevent over-felling, the extraction of the timber and fuel of *sundri*, *passur*, *kankra* and *keora*, and of the fuel of *gengwa* and *dhundal* in boats of all sizes, will be confined to the areas prescribed for large boats. Owing to the difficulty of defining the difference between poles and fuel of *goran*, *math goran* and *kirpa*, purchasers of the fuel of these species will pay the royalty rate prescribed for poles. Under the old system of management, the export of these types of timber and fuel has been totally stopped for many years; these restrictions, therefore, will not cause any discontent, or hardship for the local people with small boats. There are one or two *chars* and islands containing young and fair quality forest, which justify better treatment than unregulated felling; cutting in these areas should not be allowed except under proper control, and according to the silvicultural rules. *Tora* is an inferior product for which there is very little demand; the felling of this species, therefore, will be allowed without restriction throughout the working circle. *Hantal* is classified as minor produce; the exploitation of this species also will be allowed without any restriction (*vide* paragraph 135 of Chapter VII).

126. Tabular summary of the rules to be observed, and the fellings to be made during the next 20 years.—

The extraction of all types of produce (excepting the timber and fuel of <i>sundri</i> , <i>passur</i> , <i>kankra</i> and <i>keora</i> , and the fuel of <i>gengwa</i> , <i>dhundal</i> , <i>goran</i> , <i>math goran</i> and <i>kirpa</i> ) in boats of 300 maunds and under; and the extraction of <i>tora</i> in boats of all maundages.	The extraction of all types of timber and fuel (excepting the fuel of <i>goran</i> , <i>math goran</i> and <i>kirpa</i> ) in boats of all maundages.	
The whole working circle.	Felling Series 1.	Felling Series 2.
No restriction, except for felling on certain new <i>chars</i> as detailed below.	From 1931-32 until 1943-44, Compartment 73 will be open to felling; and from 1944-45 to 1948-49, Compartment 74 will be open to felling.	At present, Mahasini Island and Panchania are open. As colonization proceeds, fresh areas will be opened from time to time by the Divisional Forest Officer in consultation with the Collector, 24 Parganas.

*Felling on new formations.*—The unregulated felling of species other than *goran*, *math goran*, *khalshi*, *tora* and *kirpa*, should not be allowed on Kankramari *char*, Dia Islands, Prentice Island, Swan Island, and other new formations in the Thakuran river. The crop on these *chars* should be thinned and improved according to the felling rules prescribed for Working Circle I, whenever there is a demand, and an officer for the supervision of the felling is available.

NOTE.—In order to ensure the greatest possible utilization of the crop from areas which are about to be clear-felled and colonized, it will generally be advisable to sell the material from these areas on reduced rates of royalty.

### Estimate of the possible Annual Output under the Treatment Prescribed.

127. The following statement gives a rough estimate of the possible annual yield from the forests of the working circle under the treatment prescribed:—

Species.	Estimated possible annual yields.	
	Timber. C. ft.	Fuel. C. ft.
<i>Sundri</i> .. ..	13,797	11,349
<i>Gengwa</i> .. ..	62,022	88,691
<i>Passur</i> .. ..	8,243	7,492
<i>Dhundal</i> .. ..	5,791	5,920
<i>Kankra</i> .. ..	6,711	7,028
<i>Keora</i> .. ..	1,078	1,294
<i>Baen</i> .. ..	5,069	20,436
<i>White baen</i> .. ..	602	73,357
<i>Goran</i> .. ..	91,935	27,230*
<i>Math goran</i> .. ..	25,505	5,608*
<i>Singra</i> .. ..	..	602
<i>Khalshi</i> .. ..	216	1,672
<i>Kirpa</i> .. ..	917	324*
<i>Tora</i> .. ..	..	14,774
Other kinds .. ..	9,130	18,804
Total .. ..	231,016	284,581

NOTE.—The methods used for making these estimates will be found in Appendix IX. The estimates have been based on the enumeration results of sound stems only; with the type of management prescribed, the exploitation of unsound trees will be negligible.

\* These types of fuel should only be sold at the royalty rate fixed for poles (*vide* paragraph 125).

## CHAPTER VII.

## MISCELLANEOUS PRESCRIPTIONS AND SUGGESTIONS.

## Golpatta.

128. **Condition of crop and treatment necessary.**—The sale of the leaves of *golpatta* is responsible for about one-fifth of the revenue of the division. The crop of this species has suffered much in past years from unregulated cutting. In the larger and more accessible *khals*, the rhizomes are sickly and very often dying from lack of food due to the continual loss of their leaves, whilst those far away at the sources of the small creeks are not touched. Also, under the system of unregulated cutting, it has not been possible in the past to prevent effectually the lopping of the immature and unopened new fronds, locally called *manjhi pata* or “central leaves.” There is no lack of regeneration, but young plants as soon as they had produced one saleable leaf were cut. The consequence of these abuses has been that the number of plants has dwindled year by year. Accordingly, the cutting of *golpatta* will be restricted to coupes under proper supervision, a regular cutting cycle has been prescribed, and suitable rules have been made to prevent the continuation of the aforesaid abuses.

129. **The scheme for the forests of the Khulna district.**—East of the Raimangal river, the *golpatta* will be exploited on the stem of one travelling coupe for each of the following cutting series:—

## Cutting Series—

- No. 1. Sarankhola Range.
- No. 2. Chandpai Range.
- No. 3. Khulna Range east of the Sipsah river.
- No. 4. Khulna Range west of the Sipsah river.
- No. 5. Satkhira Range.

The cutting cycle prescribed is one year, as this period is considered sufficient time for a plant to regain its former vigour and health after being cut over.

130. The following are the cutting and coupe rules to be observed for the forests east of the Raimangal river:—

(1) No area should be exploited more than once a year.

(2) New fronds, or so-called “central leaves” should not be cut; also purchasers must not be allowed to cut leaves which they do not intend to utilise, but to leave on the ground to rot. In this way, the maximum leaf surface possible will be left on the rhizome after it has been cut over, and the maximum energy will be left in the plant. Young plants with only one utilisable leaf should not be cut.

(3) The main work of coupe officers of *golpatta* coupes will be to see that rules (1) and (2) are obeyed, and that no *golpatta* in the interior of the forests is left unworked before the coupe moves on. Each purchaser should be allotted a small *khal*, or a part of a large *khal* to work in, and should not be given a fresh area until the area already allotted to him is finished. Areas near the sea-face should be worked during the calm season.

(4) As they travel over the forests, coupe officers will prepare stock maps on a 4-inch scale of the *golpatta* in each compartment. Two fair copies of these maps should be made in duplicate on tracing cloth and in Indian ink, using the same sign as has been used in the 2-inch stock maps prepared for this working plan. One copy should be sent to the Divisional Forest Office for record, and one copy kept on the coupe to facilitate the next year’s work. This applies particularly to the Satkhira

NOTE.—Khulna Range has been given two cutting series for the benefit of small boats not wishing to cross the Sipsah or to travel from Cobadak to Dhangmari.

Cutting Series where the *golpatta* is comparatively scarce, and the information on the present 2-inch stock maps very general and incomplete. In succeeding years, the map should be continually added to and altered until a complete map of all the *golpatta* east of the Raimangal is obtained. The *golpatta* on these maps should be incorporated on the 4-inch stock maps, which will be made by the marking officers of the coupes in Working Circles I and II. [See paragraph 66 (4).] Care should be taken that the *golpatta* is included on the stock map of a compartment, before it is submitted for printing.

(5) All *jhools*, masts, *mallums*; etc., which are felled and used in the *golpatta* boats, should be hammer-marked by the coupe officers before felling. They should be recorded as the outturn of the particular compartment, felling series and working circle in which they are felled. Any apparently sound trees of *sundri*, *gengwa* or *passur* of 6 inches in diameter and over which are utilised in this way in Working Circle I, should be recorded in diameter and quality classes as instructed in paragraph 67 (14) of Chapter II. (See also paragraph 12 of Appendix XI.)

131. **The scheme for the forests of the 24-Parganas district.**—In the Basirhat and Namkhana Ranges, *golpatta* is scarce; it will therefore be neither economical nor practicable to confine the cutting of *golpatta* to coupes in these two ranges. As before, the permits will be issued at revenue stations, and the cutting will not be confined to coupes. In order to prevent over-cutting, the extraction will be limited to boats not exceeding 300 maunds in capacity.

NOTE.—In these forests, *jhools*, etc., required by *golpatta* boats need not be felled on a coupe or marked before felling. They may be recorded as the outturn from the whole working circle concerned, but it will not be possible to give the details of the particular felling series and compartment in which felled.

132. **Forecast of the results of the treatment prescribed.**—It is not possible to forecast what the possibility of *golpatta* will be under this method of treatment. In the forests east of the Raimangal river, there is no doubt that the present maximum outturn will be increased by tapping the less accessible and less known areas. In two or three years' time, the more accessible rhizomes, which hitherto have been overcut, should start bearing more leaves; and in succeeding years, the younger plants protected under rule (2) of paragraph 130, will start adding to the annual harvest. (From recent observations, it has been deduced that a *golpatta* plant growing in a fresh-water area is fit to be cut for leaves when about 5 or 6 years old.) In this way, the possibility of *golpatta* in the forests of the Khulna district will gradually increase during the currency of this plan. In the Basirhat and Namkhana Ranges, namely, the forests west of the Raimangal river, *golpatta* is not capable of growing so prolifically as in the fresh-water areas further east. During the last five years, these forests have supplied only about 3 per cent. of the *golpatta* which has been exported from the division. Consequently, the embargo on the export by large boats will not disorganise the trade in any way; at the same time, the restriction in cutting should allow the crop of *golpatta* to increase, if it is capable of doing so.

### Honey and Wax.

133. The average yearly income from honey and wax during the currency of Mr. Trafford's Plan was Rs. 16,284, and for the 9 years previous to the introduction of that plan, namely, from 1903-04 to 1911-12, it was Rs. 13,952. Since 1903-04, the royalty rate has not been altered; thus there is no doubt that the rule introduced during the currency of the last plan, restricting the export to the period from the first April to the 15th June each year, has had a beneficial effect. However, the demand for honey and wax has always been in excess of the supply; consequently, further measures to accelerate the increase in the number of bees are desirable. It was prescribed in the last working plan that sanctuaries should be observed each year for the bees, both in the Khulna and 24-Parganas districts. Lot No. 7, namely, the portion of Compartment I east of the Bhola *gang*, was made a sanctuary in the Khulna district; but owing to the scarcity of patrols, no sanctuary was made in the 24-Parganas district. The best honey producing areas are the moderately salt-water forests and the probability is that the one sanctuary observed, namely, Lot No. 7 on the extreme east of the division, has not had much effect. There is no necessity to make the sanctuaries perpetual ones; in order to be effective, they need only be kept for one season. Each

year, therefore, the Divisional Officer will choose one compartment in each range to be a sanctuary for bees. The compartment will be chosen according to its convenience for effective patrol.

134. The following are the rules prescribed for the collection of honey and wax :—

(1) Permits for the collection of honey and wax are to be issued only during the period from the 1st April to the 15th June each year.

(2) The collection of honey and wax is not to be permitted within the sanctuaries chosen for the year.

(3) Collectors will be allowed to take permits from any revenue station not in charge of a forest guard, or from any coupe office.

### Other Types of Minor Produce.

135. Permits on royalty rates for the collection of *hantal*, cane, grasses, shells and other kinds of minor produce will continue to be issued without restriction; purchasers should be allowed to take permits for this type of produce from any revenue station not in charge of a forest guard, or from any coupe office. *Bhola* (*Hibiscus tiliaceus*) may be treated as a minor produce, and the exploitation of this species for fuel or any other purpose may be allowed in the same way without restriction. In the forests of the Khulna district, purchasers of minor produce needing *jhools*, masts, *mallums*, etc., will proceed to any type of coupe, and cut them under the supervision of a coupe officer; in the same way as has been indicated in paragraph 130(5), such fellings should be recorded as the outturn of the particular compartment, felling series and working circle concerned, and the diameter and quality class of any apparently sound trees of *sundri*, *gengwa* or *passur* of 6 inches in diameter and over, which are felled for these purposes in Working Circle I, should be noted by the coupe officer. In the forests of the 24-Parganas district, *jhools*, etc., required for boats exporting minor produce need not be felled on a coupe or marked before felling, and they may be recorded as the outturn from the whole working circle concerned: it will not be possible to record the particular compartment or felling series in which they are felled.

### Subsidiary Regulations and Suggestions.

136. **Cleanings, thinnings, or other improvement fellings.**—No prescriptions of this nature, other than those already detailed in previous chapters, are considered necessary.

137. **Regulation of rights and concessions.**—No grazing rights exist over the forests in the division, nor is there any demand for grazing. At present, fishing in the rivers and *khals* intersecting the forests is allowed free and without restriction; but, as already stated in paragraph 36 of Part I, the question of the regulation of fishing, both from the point of view of forest control, and to facilitate the introduction of measures for the conservation of the fish, is being considered by the Bengal Government. Chittagonian fishermen, who settle on the sea-face of Dubla Island in the cold weather to catch and dry fish, should continue to be charged Re. 1 per head in order to prevent this practice becoming a right, and to compensate for fuel and other forest produce which they consume. If possible, the Divisional Forest Officer, or a gazetted officer should collect this revenue each year: it is not desirable to leave this work to a subordinate. The fishermen should not be allowed to settle in any place other than the one allotted to them on Dubla Island.

138. **Sowings, plantings, etc.**—No sowings or plantings are considered necessary. Generally speaking, natural regeneration springs up very rapidly and needs no aid other than judicious felling and, in some cases, the prevention of excessive browsing by deer. In the better quality forests, blanks are rare: in the poorer forests, the barren areas of hard salty soil are probably incapable of bearing any crop. Under the system of management prescribed, it is expected that the frequent gaps caused by past unregulated felling will gradually fill up. ↗

139. The time will come when the demand will justify the reclamation of blanks which do not regenerate naturally. Small experimental plantings and sowings are



recommended in such areas, particularly in those of the eastern forests which are at present covered with *bhola*, *tiger fern* or other weeds. It is not known whether the blanks in the *goran* forest will fill up naturally or not. Blanks in the better quality *goran* forest should be chosen, and watched as observation plots. In the meantime, experiments with the artificial regeneration of *goran* are recommended, in case such regeneration becomes necessary. More information is needed regarding the growth and treatment of *golpatta*. Experiments should be continued with the artificial sowing of this species, and experimental plots may be formed with the idea of determining the best cutting cycle.

140. **Floating craft.**—The repairs of the steam launches and cutters are controlled under the Bengal Government pooling scheme. Motor launches should be overhauled and repaired once a year, and accommodation flats every two years. (See Rules 23 and 24 of Appendix XII.) Accommodation and other boats should be sent to the Khulna Depot for thorough overhaul and repair every 3 years. Dinghies should be sent to Khulna for the same purpose once in every 4 years. Boats and dinghies, too old for repair, should be replaced by reconstruction without delay, in order to prevent the disorganisation of the work of the division through lack of boats. The extra craft required to introduce the system of management prescribed in this plan will be found detailed in Chapter VIII.

141. **Bharani khals.**—The *Bainsanta khal* in Compartment 31, and the *Cheilabogi khal* in Compartment 39 are important *bharanis* between the Passur and Sipsah river systems, navigable by launch at high tide. Every year, patrol officers should be ordered to cut any trees overhanging these *khals*. The work started on the artificial boundary *khal* between the *Bogi khal* and the Sarankhola Revenue Station should be continued, and an attempt made to make it passable for average sized timber boats; if this work is successful, it will put an end to the practice of zamindars in this locality of realising exorbitant fees for boats using the artificial *bharanis* passing through their lands.

142. **Water-supply.**—The supply of drinking water to the staff of the numerous coupes prescribed by this plan, will be carried to the forest in departmental water-carrying boats; in order to economise in the use of these boats, the construction of a few fresh-water tanks on some of the sandy areas near the sea-face is recommended.

143. **Buildings.**—No special prescriptions with regard to buildings are necessary, but suitable quarters for the use of Range Officers should be built when funds permit.

### The System of Permits and Entry Passes.

144. As the whole of the extraction from the forests in the Khulna district has been confined to coupes by the prescriptions of this plan, the work of the revenue stations is reduced to the measuring and registration of boats. Consequently, it will no longer be necessary to keep revenue station officers at these stations; foresters at the more important stations and forest guards at others will suffice. As forest guards do not understand English, an alternative form of the Boat Registration Certificate in the vernacular will be required; this form is given in Appendix X.

145. Owing to danger of theft, especially by small boats, it is not advisable to allow purchasers to proceed to the coupes in the forest without some form of pass. Consequently, before entering the forest, each boat will take out an entry pass in the form given in Appendix X. The fees payable for such passes will be small. The scale of fees to be charged has been fixed provisionally in Rule 2 of Appendix XII; it may be revised from time to time, if found unsuitable. The passes are to be surrendered at the coupe to which the purchaser and his boats proceed, and the fee paid by him will be deducted from the price of his permit paid at the coupe; the introduction of these passes, therefore, will cause no extra expense to the purchaser. Unless they abuse the privilege, there is no need for auction purchasers to take out entry passes in this way. The permits issued at the coupes will be on the usual form at present in use, and as prescribed by notification No. 2821 For., dated the 8th November 1906. Right of way certificate will be issued at the coupes; there will be no need for purchasers to present their boats for examination at a revenue station unless, subsequently, this check is found necessary.

146. In the Basirhat and Namkhana Ranges, permits will be issued at revenue stations in the same way as before, but in the Basirhat Range where the extraction

is confined to annual coupes, permit-holders will not be granted right of way certificates on their return to the revenue station, unless the permit is endorsed as correct by the officer in charge of the coupe.

147. Permits for exporting forest produce from lands leased out under the rules published in a Bengal Government notification, dated the 12th November 1879, or under any subsequent rules, and right of way passes for exporting forest produce from lands leased out prior to the introduction of the said rules of 1879, will be issued in the same way as before, and according to the notifications at present in force. The same applies to the issue of right of way passes to boats which are loaded with forest produce purchased in localities contiguous to the forests, and on which the royalty rate has already been paid.

148. If, owing to lack of funds, the *goran* and *golpatta* extraction is not confined to coupes but remains unregulated, it will be necessary to keep the present standard of the staff at the revenue stations for issuing permits for these types of produce. In such an eventuality, the system indicated above for the Basirhat Range may be extended to the ranges in the Fhulna district, and the system of entry passes detailed in paragraph 144 need not be adopted. For this reason, and because of other eventualities which may arise when the reorganisation as prescribed in this plan is put into practice, it is not advisable to revise, and include the system of entry passes in the transit rules (as published in notification No. 2821 For., dated the 8th November 1906) until the plan has been in operation for six months or so. As all the forests in the Khulna district are reserved, there can be nothing illegal in the issue of entry passes during this interim period. Rules for guidance in the issue of permits, entry passes, etc., are given in Appendix XII.

### The Collection of Data and the Upkeep of Records.

149. **Rate of growth.**—The existing sample and experimental plots of the division are described in Chapter VI of Part I. Other than the data obtained, or expected in the future from these plots, information is still needed regarding the growth of the following:—

- (1) Third quality *sundri*, and one or two more plots of second quality *sundri*, in order to check the results obtained from the records of the old sample plots. (See Appendix IV.)
- (2) First and second quality *gengwa*.
- (3) *Passur*, all qualities.
- (4) *Dhundal*, third and fourth qualities.
- (5) *Kankra*, all qualities.
- (6) *Baen*, all qualities.
- (7) *Goran* in the Basirhat Range.
- (8) Any other species which yield a large revenue, whenever they occur in the sample or increment plots.

The method of obtaining this information is left to the discretion of the Silviculturist and Divisional Officers. For items (2) to (6) inclusive, pure forests of the species concerned are not available; mixed plots or sample lines, therefore, are recommended, in which all species of trees should be measured, and classified into their quality class. Increment figures for the average tree are more important for the type of management possible in the Sundarbans. Figures of volume increment per acre are of very little use, because absolutely pure and fully stocked areas of any species are seldom met with.

150. **Volume tables.**—Volume tables for various species will be found in Appendix V; the details from which these tables were compiled will be found in the forest journal. Before really reliable tables can be compiled, about 50 trees of each diameter class in each quality for each species need to be measured. During the currency of this plan, therefore, officers on coupes should continue to measure the volumes of trees felled, whenever they have the time and opportunity. It is not advisable to calculate the volumes according to the material actually utilised, as this will depend too much on the supply of available timber, the demand, and the particular locality of the coupe. For the calculation of the volumes of the nine species of which sample trees have already been felled and measured, the minimum

sizes detailed in Appendix V should be used. No sample trees of important species, such as *singra*, *kankra* and *amur* have yet been measured; their volume tables given in Appendix V are merely rough estimations. After careful examination of the usual sizes being exploited on the various coupes, suitable minimum dimensions may be prescribed by the Divisional Officer for the measurement of sample trees of these species. When sufficient data has been obtained in this way, fresh and more reliable volume tables for the division may be prepared.

151. **Control and outturn forms.**—The present control and outturn form No. 2 as prescribed by the Forest Code, is not suitable for the various types of control prescribed in this plan. Moreover, the form is large, unwieldy, and not handy for ready reference. In its place, seven forms have been prescribed as depicted and explained in Appendix XI. This appears a formidable number, but the forms are all of foolscap size, and can be typed in duplicate or triplicate without extra labour. The first five forms deal with only timber and fuel, not minor produce. Form A gives the details of the fellings in each compartment. Forms B and C are for the control of the principal fellings of each working circle by tea; they are devised with the object of recording the progress of the fellings of each important species. Form D is a special one for Working Circle I, which will show whether the prescriptions regarding the volume outturn in that working circle are being followed or not. Form E is a summary by felling series and working circles of the outturn and revenue derived from each type of felling. Form F is solely for the control of the prescriptions made for *golpatta* in paragraphs 129 and 130 of the plan; in addition, it records the outturn of this species from each compartment, and will indicate whether the crop is improving, or deteriorating under the management prescribed. The last Form G is for recording the outturn of minor produce range by range. All forms, except Form A which is purely for use within the division, should be submitted to the Conservator each year. Copies of all forms should be kept in loose leaved books at the Divisional Office; spare copies of Form A should also be kept in the Forest Journal in the part allotted to the compartment concerned, in order that there may be a ready reference for the history of the fellings in each compartment. The forms recording outturn have been devised in such a way that the information generally needed regarding the revenue and outturn of each species will be readily available. Paragraphs 1 to 14 inclusive of Appendix XI give preliminary instructions regarding the compilation of annual figures, and the submission of the monthly returns of outturn and revenue. It is most important that these instructions should be followed immediately the management prescribed in this plan is put into force; otherwise, it will not be possible to fill in all the information required by these forms with any degree of accuracy, or without an abnormal expenditure of labour.

152. **The forest journal.**—Since the formation of the division, no less than four forest journals have been started and abandoned. In order to avoid this in future, a new forest journal in a loose leaved book has been started. In this way, should the present headings in the journal become unsuitable, revised headings will merely involve a reshuffling of the pages and not the rewriting of the whole journal; also, old and obsolete information which is no longer required, may be taken out and put into a separate volume or destroyed. For the sake of legibility, entries in the journal should be typed; and in order to avoid the risk of loss, the journal should be typed in duplicate, one copy of the journal being always kept in the Divisional Office, and the other by the Divisional Officer. The small loose leaved book, containing lists of quotations and prices paid for the various types of stores, etc., generally in use in the division, is to be kept up to date, and should be considered as part of the forest journal.

153. **Preparation and maintenance of maps.**—Prescriptions have already been made in paragraph 66(2) and (4) for the gradual preparation of stock maps for each compartment of Working Circle I, on a scale of 4 inches to the mile. They will show the growing stock and the courses of the various small *khals* in greater detail than is at present available. Paragraph 86 extends these prescriptions to the forests of Working Circle II, and paragraph 130(4) provides for the inclusion of *golpatta* in these stock maps. As indicated in paragraph 13, 200 copies of each of the stock maps prepared for this plan have been printed, but the plates have not been kept. Copies which are not in use, therefore, should be kept carefully in the cabinets provided for them, and they should be examined from time to time for insect attack. A list of the maps prepared in connection with this plan is given in Appendix XIV.

## CHAPTER VIII.

THE ESTABLISHMENT, FLOATING CRAFT AND EXPENDITURE  
NECESSARY TO INTRODUCE AND MAINTAIN THE  
MANAGEMENT PRESCRIBED.

## Establishment and Floating Craft Required.

154. The proposals embodied in this plan involve an appreciable increase in the establishment and craft, and an extensive alteration in the organisation of the division. For the guidance of the Divisional Forest Officer who is to carry out the plan, it is necessary, therefore, to indicate the staff, boats, etc., required to start the system of management proposed, and their organisation range by range in some detail. The following are the minimum requirements which are considered necessary, and without which, it will not be possible to carry out the prescriptions of this working plan:—

## I.—SARANKHOLA RANGE.

## (1) Range.

One gazetted officer, or senior forest ranger in charge of range with one motor launch and *dinghy*. The crew of the motor launch will be:—One serang and 1 engine driver on Rs. 35—3—50, 1 kassub on Rs. 21, 1 lascar on Rs. 18—<sup>1</sup>/<sub>5</sub>—19—<sup>1</sup>/<sub>10</sub>—20 and 1 sweeper on Rs. 18 per mensem.

## (2) Coupes.

(i) *Coupe for Working Circle I, Felling Series 1.*—One deputy ranger in charge, 2 forester assistants, 3 forest guards, 13 boatmen (4 for deputy ranger, 3 each for foresters, 1 each for forest guards), 1 accommodation boat (foresters and forest guards will live in temporary houses built ashore) and 6 *dinghies* (one for each officer and forest guard).

(ii) The coupe for Working Circle II, Felling Series 1 has been included in Chandpai Range, as most of this felling series belongs to that range.

(iii) *Coupe for goran, Working Circle IV, Felling Series 1.*—One forester in charge, 1 forest guard, 5 boatmen, 1 accommodation boat and 2 *dinghies*.

(iv) *Golpatta coupe, Cutting Series 1.*—One deputy ranger in charge, 2 forest guards, 7 boatmen, 2 accommodation boats and 3 *dinghies*.

(v) *Marking coupe.*—One junior forest ranger in charge, 1 forester assistant, 12 boatmen who will also act as marking coolies, 1 accommodation boat, 1 cooly boat and 2 *dinghies*.

(vi) *Water-supply for the coupes.*—Six boatmen and 2 water boats.

(vii) *Total for coupes.*—One junior forest ranger, 2 deputy rangers, 4 foresters, 6 forest guards, 43 boatmen, 5 accommodation boats, 1 cooly boat, 2 water boats and 13 *dinghies*.

## (3) Revenue Stations and Patrols.

(i) *Supoti Revenue Station.*—One forest guard, 3 boatmen and 2 *dinghies*.

(ii) *Sarankhola Revenue Station.*—One forester, 1 forest guard, 3 boatmen and 2 *dinghies*. (The forester will also act as range clerk).

(iii) *Bogi Revenue Station.*—One forest guard, 3 boatmen and 1 *dinghy*.

(iv) Four patrols with 1 forester, 5 boatmen, 1 accommodation boat and 1 *dinghy* each; namely, the Bogi, Sarankhola and Supoti Forest Patrols and the Dhansagar-Supoti Boundary Patrol, i.e., 4 foresters, 20 boatmen, 4 accommodation boats and 4 *dinghies*.

(v) *For miscellaneous work.*—One forester, 4 boatmen, 1 accommodation boat and 1 dinghy.

(vi) *Total for revenue stations and patrols.*—Six foresters, 3 forest guards, 33 boatmen, 5 accommodation boats and 10 dinghies.

(4) *Total for the range.*

One gazetted officer or senior forest ranger, 1 junior forest ranger, 2 deputy rangers, 10 foresters, 9 forest guards, 1 serang, 1 kassub, 1 lascar, 1 engine driver, 1 sweeper, 76 boatmen, 1 motor launch, 10 accommodation boats, 1 cooly boat, 2 water boats and 24 dinghies.

II.—CHANDPAI RANGE.

(1) *Range.*

One gazetted officer, or senior forest ranger in charge of range, etc., as in Sarankhola Range.

(2) *Coupes.*

(i) *Coupe for Working Circle I, Felling Series 2.*—One deputy ranger, 3 foresters, 3 forest guards, 16 boatmen, 1 accommodation boat and 7 dinghies.

(ii) *Coupe for Working Circle II, Felling Series 1.*—One deputy ranger, 1 forester, 2 forest guards, 9 boatmen, 1 accommodation boat and 4 dinghies.

(iii) *Goran coupe, Working Circle IV, Felling Series 2.*—One forester, 1 forest guard, 5 boatmen, 1 accommodation boat and 2 dinghies.

(iv) *Golpatta coupe, Cutting Series 2.*—One deputy ranger, 2 forest guards, 7 boatmen, 2 accommodation boats and 3 dinghies.

(v) *Marking coupe.*—One junior forest ranger, 1 forester assistant, 12 boatmen, 1 accommodation boat, 1 cooly boat and 2 dinghies.

NOTE.—The establishment given to both the Sarankhola and Chandpai Ranges for the marking coupe is sufficient to mark the coupes for Working Circle I in about 9 months. For the remainder of the year, the establishment of these two coupes may be combined for marking the coupe for Working Circle II, Felling Series 1.

(vi) *Water-supply for the coupes.*—Nine boatmen and 3 water boats.

(vii) *Total for the coupes.*—One junior forest ranger, 3 deputy rangers, 6 foresters, 8 forest guards, 58 boatmen, 6 accommodation boats, 1 cooly boat, 3 water boats and 18 dinghies.

(3) *Revenue Stations and Patrols.*

(i) *Dhansagar Revenue Station.*—One forest guard, 3 boatmen and 1 dinghy.

(ii) *Jewdhara Revenue Station.*—One forest guard, 3 boatmen and 1 dinghy.

(iii) *Chandpai Revenue Station.*—One forester (also to act as range clerk), 1 forest guard, 3 boatmen and 2 dinghies.

(iv) *Jewdhara Forest Patrol.*—One forester, 5 boatmen, 1 accommodation boat and 1 dinghy.

(v) *Chandpai-Dhansagar Boundary Patrol.*—One forester, 5 boatmen, 1 accommodation boat and 1 dinghy.

(vi) *For miscellaneous work (including Fisherman's Hut Patrol).*—One forester 4 boatmen, 1 accommodation boat and 1 dinghy.

(vii) *Total for revenue stations, patrols, etc.*—Four foresters, 3 forest guards, 23 boatmen, 3 accommodation boats and 7 dinghies.

(4) *Total for the Range.*

One gazetted officer or senior forest ranger, 1 junior forest ranger, 3 deputy rangers, 10 foresters, 11 forest guards, 1 serang, 1 kassub, 1 lascar, 1 engine driver, 1 sweeper, 81 boatmen, 1 motor launch, 9 accommodation boats, 1 cooly boat, 3 water boats and 26 dinghies.

## III.—KHULNA RANGE.

## (1) Range.

One gazetted officer, or senior forest ranger in charge of range, etc., as in Sarankhola Range.

## (2) Coupes.

(i) *Coupe for Working Circle I, Felling Series 3.*—One deputy ranger, 2 foresters, 2 forest guards, 12 boatmen, 1 accommodation boat and 5 dinghies.

(ii) *Coupe for Working Circle I, Felling Series 4.*—One deputy ranger, 1 forester, 2 forest guards, 10 boatmen, 1 accommodation boat and 4 dinghies.

(iii) *Coupe for Working Circle II, Felling Series 2.*—One deputy ranger, 2 foresters, 3 forest guards, 13 boatmen, 1 accommodation boat and 6 dinghies.

(iv) *Goran coupe, Working Circle IV, Felling Series 3.*—One forester, 2 forest guards, 7 boatmen, 2 accommodation boats and 3 dinghies.

(v) *Golpatta coupe, Cutting Series 3.*—One deputy ranger, 2 forest guards, 7 boatmen, 2 accommodation boats and 3 dinghies.

(vi) *Golpatta coupe, Cutting Series 4.*—One deputy ranger, 2 forest guards, 7 boatmen, 2 accommodation boats and 3 dinghies.

(vii) *Marking coupe.*—One junior forest ranger, 2 foresters, 18 boatmen, 2 accommodation boats, 1 cooly boat and 3 dinghies.

(viii) *Water-supply for the coupes.*—Twelve boatmen and 4 water boats.

(ix) *Total for the coupes.*—One junior forest ranger, 5 deputy rangers, 8 foresters, 13 forest guards, 86 boatmen, 11 accommodation boats, 1 cooly boat, 4 water boats and 27 dinghies.

## (3) Revenue Stations and Patrols.

(i) *Dhangmari Revenue Station.*—One forester, 1 forest guard, 4 boatmen, and 2 dinghies.

(ii) *Sutarkhali Revenue Station.*—One forest guard, 3 boatmen and 1 dinghy.

(iii) *Kalabogi Revenue Station.*—One forest guard, 3 boatmen and 1 dinghy.

(iv) *Nalianala Revenue Station.*—One forester (also to act as range clerk), 1 forest guard, 3 boatmen and 2 dinghies.

(v) *Baniakhali Revenue Station.*—One forest guard, 3 boatmen and 1 dinghy.

(vi) *Cassiabad Revenue Station.*—One forest guard, 3 boatmen and 1 dinghy.

(vii) *Cobadak Revenue Station.*—One forester, 1 forest guard, 3 boatmen and 2 dinghies.

(viii) *Six patrols, namely, the Dacope, Baniakhali and Cobadak Forest patrols, and the Dhangmari-Kalabogi, Kalabogi-Baniakhali and Baniakhali-Cobadak Boundary Patrols.*—Six foresters, 30 boatmen, 6 accommodation boats and 6 dinghies.

(ix) *For miscellaneous work.*—One forester, 4 boatmen, 1 accommodation boat and 1 dinghy.

(x) *Total for revenue stations and patrols.*—Ten foresters, 7 forest guards, 56 boatmen, 7 accommodation boats and 17 dinghies.

## (4) Total for the Range.

One gazetted officer or senior forest ranger, 1 junior forest ranger, 5 deputy rangers, 18 foresters, 20 forest guards, 1 serang, 1 kassub, 1 lascar, 1 engine driver, 1 sweeper, 142 boatmen, 1 motor launch, 18 accommodation boats, 1 cooly boat, 4 water boats and 45 dinghies.

## IV.—SATKHIRA RANGE.

## (1) Range.

One gazetted officer or senior forest ranger in charge of range, etc., as in Sarankhola Range.

(2) *Coupes*.

(i) *Coupe for Working Circle II, Felling Series 3*.—One deputy ranger in charge, 1 forester assistant, 2 forest guards, 9 boatmen, 1 accommodation boat and 4 *dinghies*.

(ii) *Coupe for Working Circle II, Felling Series 4*.—One deputy ranger in charge, 2 forester assistants, 2 forest guards, 12 boatmen, 1 accommodation boat and 5 *dinghies*.

(iii) *Goran coupe, Working Circle IV, Felling Series 4*.—One forester, 1 forest guard, 5 boatmen, 1 accommodation boat and 2 *dinghies*.

(iv) *Goran coupe, Working Circle IV, Felling Series 5*.—One forester, 1 forest guard, 5 boatmen, 1 accommodation boat and 2 *dinghies*.

(v) *Golpatta coupe, Cutting Series 4*.—One deputy ranger, 2 forest guards, 7 boatmen, 2 accommodation boats and 3 *dinghies*.

(vi) *Marking coupe*.—One deputy ranger, 1 forester, 12 boatmen, 1 accommodation boat, 1 cooly boat and 2 *dinghies*.

(vii) *Water supply for the coupes*.—Three water boats and 9 boatmen.

(viii) *Total for coupes*.—Four deputy rangers, 6 foresters, 8 forest guards, 59 boatmen, 7 accommodation boats, 1 cooly boat, 3 water boats and 18 *dinghies*.

(3) *Revenue Stations and Patrols*.

(i) *Burigoalni Revenue Station*.—One forester, 1 forest guard, 3 boatmen and 2 *dinghies*.

(ii) *Kadamtala Revenue Station*.—One forest guard, 3 boatmen and 1 *dinghy*.

(iii) *Koikhali Revenue Station*.—One forester (also to act as range clerk), 1 forest guard, 4 boatmen and 2 *dinghies*.

(iv) *Five patrols, namely, the Burigoalni, Kadamtala and Koikhali Forest Patrols, and the Cobadak-Kadamtala and Kadamtala-Sahebkhali Boundary Patrols*.—Five foresters, 25 boatmen, 5 accommodation boats and 5 *dinghies*.

(v) *For miscellaneous work*.—One forester, 4 boatmen, 1 accommodation boat and 1 *dinghy*.

(vi) *Total for revenue stations and patrols*.—Eight foresters, 3 forest guards, 39 boatmen, 6 accommodation boats and 11 *dinghies*.

(4) *Total for the Range*.

One gazetted officer or senior forest ranger, 4 deputy rangers, 14 foresters, 11 forest guards, 1 serang, 1 kassub, 1 lascar, 1 engine driver, 1 sweeper, 98 boatmen, 1 motor launch, 13 accommodation boats, 1 cooly boat, 3 water boats and 30 *dinghies*.

## V.—BASIRHAT RANGE.

(1) *Range*.

One gazetted officer or senior forest ranger in charge of range, etc., as in Sarankhola Range.

(2) *Coupes*.

[In this range, the coupes for Working Circle III and Working Circle IV coincide, and one coupe officer will be in charge of the fellings for both working circles.]

(i) *Coupe for Working Circle III, Felling Series 1, main fellings, and for Working Circle IV, Sub-series (a)*.—One forester, 1 forest guard, 6 boatmen, 2 accommodation boats and 2 *dinghies*.

(ii) *Coupe for Working Circle IV, Sub-series (b), and for Working Circle III, Felling Series I, subsidiary fellings.*—One forester, 1 forest guard, 5 boatmen, 1 accommodation boat and 2 dinghies.

(iii) *Coupe for Working Circle III, Felling Series 2, main fellings, and for Working Circle IV, Sub-series (c).*—One forester, 1 forest guard, 6 boatmen, 2 accommodation boats and 2 dinghies.

(iv) *Coupe for Working Circle IV, Sub-series (d), and for Working Circle III, Felling Series 2, subsidiary fellings.*—One forester, 1 forest guard, 5 boatmen, 1 accommodation boat and 2 dinghies.

(v) *Water-supply for the coupes.*—Six boatmen and 2 water boats.

(vi) *Total for coupes.*—Four foresters, 4 forest guards, 28 boatmen, 6 accommodation boats, 2 water boats and 8 dinghies.

### (3) *Revenue Stations and Patrols.*

(i) *Sahebkhali Revenue Station.*—One revenue station officer, 1 forest guard, 4 boatmen and 2 dinghies.

(ii) *Rampura Revenue Station.*—One revenue station officer, 1 forest guard, 3 boatmen and 2 dinghies.

(iii) *Basanti Revenue Station.*—One revenue station officer, 1 forest guard, 3 boatmen and 2 dinghies.

(iv) *Matla Revenue Station.*—One revenue station officer (who will also act as range clerk,) 1 forest guard, 2 boatmen and 1 dinghy.

(v) *Three patrols, namely, the Rampura and Basanti Forest Patrols and the Basirhat Boundary Patrol.*—Three foresters, 15 boatmen, 3 accommodation boats and 3 dinghies.

(vi) *For miscellaneous work.*—One forester, 4 boatmen, 1 accommodation boat and 1 dinghy.

(vii) *Total for Revenue Stations and Patrols.*—Four foresters, 4 revenue station officers, 4 forest guards, 31 boatmen, 4 accommodation boats and 11 dinghies.

### (4) *Total for the Range.*

One gazetted officer or senior forest ranger, 8 foresters, 4 revenue station officers, 8 forest guards, 1 serang, 1 kassub, 1 lascar, 1 engine driver, 1 sweeper, 59 boatmen, 1 motor launch, 10 accommodation boats, 2 water boats and 20 dinghies.

## VI.—NAMKHANA RANGE.

### (1) *Range.*

One forest ranger in charge of range with 5 boatmen, 1 accommodation boat and 1 dinghy.

### (2) *Coupes*

Nil.

### (3) *Revenue Stations and Patrols.*

(i) *Cooltollah Revenue Station.*—One revenue station officer, 1 forest guard, 3 boatmen and 2 dinghies.

(ii) *Nalkora Revenue Station.*—One revenue station officer, 1 forest guard, 3 boatmen and 2 dinghies.



(iii) *Namkhana Revenue Station*.—One revenue station officer (also will act as range clerk), 1 forest guard, 4 boatmen, 1 jolly boat and 1 *dinghy*.

(iv) *Shikerpur Revenue Station*.—One revenue station officer, 1 forest guard, 4 boatmen, 1 jolly boat and 1 *dinghy*.

(v) *Three patrols, namely, the Cooltollah, Nalkora and Shikerpur Forest Patrols*.—Three foresters, 15 boatmen, 3 accommodation boats and 3 *dinghies*. (Shikerpur Patrol boat to be the sailing cutter "Merlin".)

(4) *Total for the Range.*

One forest ranger, 3 foresters, 4 revenue station officers, 4 forest guards, 34 boatmen, 4 accommodation boats, 2 jolly boats and 10 *dinghies*.

NOTE.—The establishment and craft detailed for this range does not include the staff and *dinghy* required for the proposed station between Nalkora and Namkhana, the introduction of which is still under consideration by Government.

VII.—DIRECTION AND MISCELLANEOUS.

(1) Divisional Forest Officer and 1 forester to act as his camp clerk and collect revenue, etc., with S.L. "Harrier", 1 jolly boat, 1 *dinghy*, and crew of S.L. "Harrier" as follows:—One serang on Rs. 60—3—75, 1 suckani on Rs. 26, 1 tindal on Rs. 24, 1 kassub on Rs. 21, 3 lascars on Rs. 18—1/5—19—1/10—20, 1 engine driver on Rs. 60—3—75, 1 engine room tindal on Rs. 27, 3 firemen greasers and 1 electric stoker on Rs. 24, 1 cook and 1 sweeper on Rs. 18.

(2) One Assistant Conservator of Forests as assistant, with S.L. "Hawk," 1 jolly boat, 1 *dinghy* and crew of S.L. "Hawk" similar to that of S. L. "Harrier."

(3) To act as relief for launches and motor boats when they are under repair, and to be used for towing work:—S.C. "Helen Grey" with *dinghy* and crew as follows:—One serang on Rs. 40—3—55, 1 suckani on Rs. 26, 1 kassub on Rs. 21, 1 lascar on Rs. 18—1/5—19—1/10—20, 1 engine driver on Rs. 40—3—55, 1 engine room kassub and 1 fireman greaser on Rs. 24.

(4) For towing work, and to act as relief for motor boats when they are under repair: S.C. "Dorothy" with *dinghy* and crew as follows:—One serang on Rs. 35—3—50, 1 suckani on Rs. 26, 1 kassub on Rs. 21, 1 engine driver on Rs. 35—3—50, 1 engine room kassub and 1 fireman greaser on Rs. 24.

(5) To carry coal, petrol, fresh water and other stores throughout the division: Flat "Swan", 1 jolly boat and 1 *dinghy* with crew as follows:—One suckani on Rs. 26, 4 lascars, on Rs. 18—1/5—19—1/10—20 and 1 sweeper on Rs. 18.

(6) *Khulna Boat Repair Dépôt*.—One revenue station officer in charge (also to act as Court Conducting Officer for the Khulna district), 1 forester assistant, 1 store overseer, 3 forest guards, 2 carpenters, 2 caulkers, 12 boatmen, 1 timber-carrying boat for departmental work and 2 *dinghies*. Also the following reserve craft under repair:—Eight accommodation boats, 1 cooly boat, 1 water boat and 10 *dinghies*.

(7) *Narkeldanga Forest Station*.—One revenue station officer in charge and 2 forest guards. As before, the revenue station officer will act as Court Conducting Officer, 24-Parganas district, Divisional Forest Officer's agent for purchasing stores in Calcutta, and will check boats loaded with Sundarbans forest produce coming in the Narkeldanga Canal.

(8) *Total for Direction and Miscellaneous*.—Divisional Forest Officer, 1 Assistant Conservator of Forests, 2 foresters, 2 revenue station officers, 1 overseer, 5 forest guards, 4 serangs, 5 suckanies, 2 tindals, 4 kassubs, 11 lascars, 4 engine drivers, 2 engine room tindals, 12 stokers, etc., 2 cooks, 3 sweepers, 2 carpenters, 2 caulkers, 12 boatmen, 2 steam launches, 2 steam cutters, the Flat "Swan", 8 accommodation boats, 1 cooly boat, 1 water boat, 3 jolly boats, 17 *dinghies*, and 1 timber carrying boat.

NOTE.—The foregoing distribution is not intended to be prescriptive; when working this scheme, it will probably be found that more men are wanted on one coupe and less on another, etc. It will act as a guide, however, for the preliminary distribution of men and craft for commencing the operations prescribed.

155. **Summary.**—The following statement is a summary of the distribution given in the preceding paragraph :—

Particulars.	Saran- khola Range.	Chand- pai Range.	Khulna Range.	Sat- khira Range.	Basirhat Range.	Nam- khana Range.	Direction and Miscel- laneous.	Total for the division.
<b>Establishment required.</b>								
<b>(1) Gazetted officers—</b>								
Divisional Forest Officer	..	..	..	..	..	..	1	1
Other gazetted officers ..	1	..	1	..	..	..	1	3
<b>(2) Subordinates—</b>								
*Senior forest rangers ..	..	1	..	1	1	..	..	3
*Junior forest rangers ..	1	1	1	..	..	1	..	4
Deputy rangers ..	2	3	5	4	..	..	..	14
Foresters ..	10	10	18	14	8	3	2	65
Revenue station officers ..	..	..	..	..	4	4	2	10
Forest guards ..	9	11	20	11	8	4	5	68
<b>(3) Lascar establishment—</b>								
Serangs ..	1	1	1	1	1	..	4	9
Suckanies ..	..	..	..	..	..	..	5	5
Tindals ..	..	..	..	..	..	..	2	2
Kassubs ..	1	1	1	1	1	..	4	9
Lascars ..	1	1	1	1	1	..	11	16
Engine drivers ..	1	1	1	1	1	..	4	9
Engine room tindals ..	..	..	..	..	..	..	2	2
Stokers and engine room kassubs ..	..	..	..	..	..	..	12	12
Cooks ..	..	..	..	..	..	..	2	2
Sweepers ..	1	1	1	1	1	..	3	8
(4) Boatmen ..	76	81	142	98	59	34	12	502
<b>(5) Miscellaneous—</b>								
Overseers ..	..	..	..	..	..	..	1	1
Carpenters ..	..	..	..	..	..	..	2	2
Caulkers ..	..	..	..	..	..	..	2	2
<b>Craft required.</b>								
(1) Steam launches ..	..	..	..	..	..	..	2	2
(2) Steam cutters ..	..	..	..	..	..	..	2	2
(3) Accommodation flats ..	..	..	..	..	..	..	1	1
(4) Motor launches ..	1	1	1	1	1	..	..	5
(5) Accommodation boats ..	10	9	18	13	10	4	8	72
(6) Cooly boats ..	1	1	1	1	..	..	1	5
(7) Water boats ..	2	3	4	3	2	..	1	15
(8) Jolly boats.. ..	..	..	..	..	..	2	3	5
(9) Dinghies ..	24	26	45	30	20	10	17	172
(10) Timber carrying boat ..	..	..	..	..	..	..	1	1

\*Senior forest rangers means rangers drawing over Rs. 100 per mensem, and junior forest rangers means those drawing Rs. 100 or less according to the present scale of pay.

NOTE.—The proposals in this plan involve no changes in the ministerial establishment; they have therefore been omitted from this statement, and from the distribution given in the preceding paragraph.

### Initial Expenditure Necessary.

156. The main portion of the initial capital outlay to be incurred before the form of management detailed in this plan can be started, will be the purchase of extra floating craft to accommodate the extra staff. The following statement gives a

comparison between the floating craft required to enable the proposals of this plan to be carried out, and the fleet under the former system of management, as it stood on the 1st April 1930:—

Type of craft.	Required for the management prescribed.	Fleet on the 1st April 1930.	Remarks.
Steam launches .. .. .	2	2	S.L. "Harrier" and S.L. "Hawk."
Steam cutters .. .. .	2	2	S.C. "Helen Grey" and S.C. "Dorothy."
Accommodation flats .. .. .	1	5	Flat "Swan" to be retained Flats "Drake", "Marion", "Vernon" and "Pelican" to be disposed of.
Motor launches .. .. .	5	1*	*The M.L. "Sylvia" is unsuitable and should be disposed of.
Accommodation boats .. .. .	72	56†	†Includes the Sailing cutter "Merlin."
Cooly boats .. .. .	5	7	} The two extra cooly boats in the fleet of the 1st April 1930, may be converted into water boats; thus only 6 extra water boats are required.
Water boats .. .. .	15	7	
Jolly boats .. .. .	5	6	} The extra jolly boat may be used as a dinghy; thus only 41 dinghies extra are required.
Dinghies .. .. .	172	130	
Timber carrying boat .. .. .	1	1	

157. The extra craft required are therefore 5 cabin motor launches, 16 accommodation boats, 6 water boats and 41 dinghies. In addition, the purchase of a certain amount of new stores for the offices of the ranges and coupes, etc., will be necessary. According to the foregoing details, the following is an estimate\* of the initial cost to be incurred:—

(1) Purchase of the following craft:—

	Rs.	Rs.
5 cabin motor launches at Rs. 17,000 each .. .. .	85,000	
16 accommodation boats at Rs. 1,810 average cost each .. .. .	28,960	
6 water boats at Rs. 875 average cost each .. .. .	5,250	
41 dinghies at Rs. 205 average cost each .. .. .	8,405	
		<u>1,27,615</u>

(2) Purchase of the following for range and coupe offices:—

Safes and galvanised iron fresh water tanks .. .. .	3,800	
Office furniture, padlocks, measuring tapes, etc. .. .. .	920	
		<u>4,720</u>
Total .. .. .		<u>1,32,335</u>

As an offset against this expenditure, a certain amount will probably be realised for the sale of the motor boat and the four accommodation flats which will no longer be required.

\*NOTE.—The rates used in this estimate, are those used in the budget estimate for 1931-32.

### Cost of Establishment.

158. In the succeeding statement, an estimate has been made of the cost of establishment required to maintain the system of management prescribed in this plan. The cost has been based on the details given in paragraphs 154 and 155, which contain no provision for spare men to act as leave reserves for the subordinate and lascar establishments. In cases of leave, it has been assumed that officiating foresters may be appointed in place of the posts vacated; for this reason, provision has been made for the payment of officiating men as an item of expenditure, but no provision has been made for leave allowance because the cost of this has already been included under pay.

#### A—Conservancy and works.

Particulars.	Annual cost.	
	Of each item.	Totals.
	Rs.	Rs.
<b>Lascar establishment.</b>		
Deck crews—		
2 serangs on Rs. 60—3—75 per mensem .. .. .	1,710*	
1 serang on Rs. 40—3—55 per mensem .. .. .	570†	
6 serangs on Rs. 35—3—50 per mensem .. .. .	3,137‡	
5 suckanies on Rs. 26 per mensem .. .. .	1,560.	
2 tindals on Rs. 24 per mensem .. .. .	576	
9 kassubs on Rs. 21 per mensem .. .. .	2,268	
16 lascars on Rs. 18—1/5—19—1/10—20 per mensem .. .. .	3,552§	
Engine room crews—		
2 drivers on Rs. 60—3—75 per mensem .. .. .	1,710*	
1 driver on Rs. 40—3—55 per mensem .. .. .	570†	
6 drivers on Rs. 35—3—50 per mensem .. .. .	3,137‡	
2 tindals on Rs. 27 per mensem .. .. .	648	
12 kassubs and stokers on Rs. 24 per mensem .. .. .	3,456	
Menials—		
2 cooks on Rs. 18 per mensem .. .. .	432	
8 sweepers on Rs. 18 per mensem .. .. .	1,728	
Pay of officiating men to replace those on leave .. .. .	1,470	26,524
<b>Boat establishment.</b>		
502 boatmen on Rs. 14 per mensem .. .. .	84,336	
Provision allowance for 414 boatmen posted to coupes and patrols at Rs. 2 per mensem .. .. .	9,936	94,272
<b>Miscellaneous.</b>		
1 store overseer on Rs. 30 per mensem .. .. .	360	
4 carpenters and caulkers .. .. .	1,260	
Travelling allowance of A—Establishment .. .. .	450	
		2,070
	Total ..	1,22,866
Less expected savings on this establishment on account of leave without pay, reduction of boat crews in the calm season, etc. .. .. .		6,500
	Net cost of A—Establishment ..	1,16,366

NOTE.—Average pay calculated on the assumption that the length of service of each incumbent in the grade will be :—  
\* 12 years, † 6 years, ‡ 7 years and § 10 years.

**B—Establishment.**

Particulars.	Annual cost.	
	Of each item.	Totals.
	Rs.	Rs.
<b>Pay of gazetted officers.</b>		
(Estimated on the same scale as that given in paragraph 86 of Part I).		
1 deputy conservator in charge of the division .. .. .	10,800	
2 assistant conservators .. .. .	12,400	
1 extra assistant conservator .. .. .	4,440	
		27,640
<b>Pay of permanent subordinate establishment.</b>		
2 forest rangers on Rs. 150 per mensem .. .. .	3,600	
1 forest ranger on Rs. 125 per mensem .. .. .	1,500	
2 forest rangers on Rs. 100 per mensem .. .. .	2,400	
1 forest ranger on Rs. 80 per mensem .. .. .	960	
1 forest ranger on Rs. 60 per mensem .. .. .	720	
4 deputy rangers on Rs. 55 per mensem .. .. .	2,640	
5 deputy rangers on Rs. 50 per mensem .. .. .	3,000	
5 deputy rangers on Rs. 45 per mensem .. .. .	2,700	
11 foresters on Rs. 40 per mensem .. .. .	5,280	
13 foresters on Rs. 35 per mensem .. .. .	5,460	
16 foresters on Rs. 30 per mensem .. .. .	5,760	
68 forest guards on Rs. 12— $\frac{1}{3}$ —16— $\frac{1}{2}$ —20 per mensem .. .. .	12,097*	
		46,117
<b>Pay of permanent clerical establishment.</b>		
(Estimated on same scale as that given in paragraph 86 of Part I).		
8 clerks on various rates of pay .. .. .	6,988	
7 peons and 1 duffry on various rates of pay .. .. .	1,368	
		8,356
<b>Pay of temporary establishment.</b>		
25 foresters on Rs. 30 per mensem .. .. .	9,000	
10 revenue station officers on Rs. 40—3—100—5—125 per mensem .. .. .	8,672*	
4 clerks on Rs. 35 per mensem .. .. .	1,680	
		19,352
<b>Allowances, etc.</b>		
Pay of officiating men in place of permanent establishment on leave .. .. .	3,200	
Local allowance .. .. .	13,800	
Travelling allowance .. .. .	10,800	
		27,800
Total B—Establishment .. .. .		1,29,265

\*Cost estimated according to the average pay of the members of these cadres during the year 1929-30.

### The Annual Cost of Management under the System Prescribed.

159. The following is an estimate of the revenue expenditure considered necessary to maintain the management prescribed :—

#### A—Conservancy and Works.

Head of service.	Particulars.	Annual cost.	
		For each item.	Totals under each head.
		Rs.	Rs.
A—I ..	Cost of extraction by departmental timber carrying boat, when not in use carrying timber for repair work .. ..	97*	97
A—II ..	Cost of establishment according to the details given in paragraph 158 .. ..	1,16,366	
	Annual or periodic repairs of the following craft :—		
	Steam launches and cutters .. .. 24,000*		
	Flat "Swan" .. .. 3,048*		
	Motor launches .. .. 4,000		
	Boats and dinghies (including renewals) .. 12,000		
		43,048	
	Marine and other stores .. ..	10,000	
	Steam coal .. ..	9,114*	
	Oil and fuel for motor boats .. ..	6,000	
	Lamp oil for offices and boats .. ..	1,200	
	Uniforms for lascar establishment .. ..	570	
	Miscellaneous .. ..	182*	
			1,86,480
A—III ..	Renewals of stores .. ..	3,000	
	Repairs of existing buildings .. ..	5,059*	
	Repairs of bunds, fresh-water tanks, upkeep of compounds, etc. ..	2,287*	
			10,346
A—IV ..	Upkeep of boundaries, etc. .. ..	8*	
A—V ..	Salving of drift and waifwood .. ..	21*	
	Law charges .. ..	206*	
	Uniforms for subordinates .. ..	633	
	Upkeep of sample plots, etc. .. ..	40*	
	Miscellaneous .. ..	1,163*	
			2,063
	Total of A—Expenditure for a normal year .. ..		1,98,994
	Very occasionally, an extra large expenditure will have to be incurred on the renewal of hulls, boilers or machinery of the launches, such as the sum of Rs. 54,750 which was spent on the renewal of the hull of the S.L. "Harrier" in 1928-29. This item was particularly large ; the yearly average of such extraordinary expenditure should not come to more than Rs. 5,000 .. ..		5,000*
	Average total for A—Expenditure .. ..		2,03,994

#### B—Establishment and office expenditure.

B—I, II and III.	Cost of the establishment according to the details given in paragraph 158.	1,29,265	1,29,265
B—IV ..	Carriage of stationery, dak and other records .. ..	168*	
	Rents, rates and taxes .. ..	1,611*	
	Postage and telegrams .. ..	1,329*	
	Commission on money orders, etc. .. ..	1,169*	
			4,277
	Total B—Establishment .. ..		1,33,542

\*These items are expected to be the same as under the old type of management ; with the exception of the repairs for the launches and steam cutters, they have been estimated by taking the average of the expenditure incurred during the three years from 1927-28 to 1929-30. Other than the pay of the establishments, the actuals for these three years have also been used as a basis for estimating the items which alter. Under A—III expenditure, the following sums have been spent during the 3 years and charged to capital expenditure, which should have been charged to revenue expenditure, namely.—Rs. 3,766 on the reconstruction of buildings and outhouses of revenue stations, Rs. 309 on earthworks for preparation of new sites for these stations, and Rs. 6,657 on the purchase of stores, which have been either renewals or articles of too small a cost to be charged to capital expenditure. These sums have been included for arriving at the average expenditure incurred during the three years. The estimate of Rs. 24,000 for the repairs of steam launches and cutters, and the Rs. 5,000 yearly average for extraordinary repair, have been estimated according to the average cost incurred on the repairs of these launches during the 6 years from 1924-25 to 1929-30.

160. The repairs for steam launches and cutters, and the yearly average of Rs. 5,000 estimated for extraordinary repair, have not been estimated according to the average expenditure incurred during the last three years. After excluding these items, the rest of A expenditure in the foregoing statement shows an excess of Rs. 35,789 over the average of the corresponding expenditure for the years 1927-28 to 1929-30. Similarly, under B expenditure, after excluding the pay of gazetted officers, there is an excess of Rs. 25,790 over the average expenditure incurred during the three years. It is estimated, therefore, that the proposals in this plan involve a total extra annual revenue expenditure of Rs. 61,579 over the average of that incurred under the old system of management during the years 1927-28 to 1929-30. A part of this excess, however, is due to the reductions in temporary establishment during these years (*vide* paragraph 86 of Part I).

## CHAPTER IX.

## FINANCIAL FORECAST AND COST OF THE PLAN.

## Estimate of the possible Revenue.

161. The following statement summarises the estimated possible annual yield of timber and fuel from all working circles under the treatment prescribed :—

## Estimated possible annual yield from all Working Circles.

Species.	*Weight of one cubic foot.	Timber.		Fuel.	
		Volume.	Corresponding weight.	Volume.	Corresponding weight.
	lbs.	C. ft.	Mds.	C. ft.	Mds.
<i>Sundri</i> .. ..	67	6,687,398	5,600,696	2,674,049	2,239,516
<i>Gengwa</i> .. ..	25	3,429,659	1,071,768	1,647,478	514,837
<i>Passur</i> .. ..	43	403,362	216,807	190,850	102,582
<i>Dhundal</i> .. ..	43	68,232	36,675	74,388	39,984
<i>Kankra</i> .. ..	54	194,515	131,298	80,929	54,627
<i>Keora</i> .. ..	40	489,293	244,647	266,388	133,194
<i>Baen</i> .. ..	52	176,958	115,023	260,246	169,160
<i>White baen</i> .. ..	52	2,830	1,840	98,862	64,260
<i>Amur</i> .. ..	43	165,398	88,901	381,116	204,850
<i>Goran</i> .. ..	60	4,112,691	3,084,518	1,205,551	904,163
<i>Math goran</i> .. ..	60	56,328	42,246	12,283	9,212
<i>Singra</i> .. ..	57	..	..	227,205	161,884
<i>Khalshi</i> .. ..	40	23,465	11,733	97,999	49,000
<i>Kirpa</i> .. ..	54	6,918	4,670	2,409	1,626
<i>Tora</i> .. ..	20	..	..	50,467	12,617
Other kinds .. ..	40	100,165	50,083	115,137	57,569
Total .. ..	..	15,917,212	10,700,905	7,385,357	4,719,081

\*These are the weights in lbs. per cubic foot of timber given for each species in Volume I, No. 1, Economic Products Series of the Indian Forest Memoirs, Indian Woods and their uses by R. S. Troup, F. C. I. *Tora* (*Egialitis rotundifolia*) is not mentioned in this book; its weight has been estimated as 20 lbs. per cubic foot. The weight of "other kinds" has been estimated at 40 lbs. per cubic foot. For calculating the corresponding weight in maunds, one maund has been taken as 80 lbs.



162. When not sold by auction, timber and fuel in this division is sold at royalty rates per maundage capacity of the boats in which it is exported. With the aid of the possible yields converted into maunds, the succeeding statement gives the possible annual yield from the reserved and protected forests, converted into revenue at values corresponding to the current royalty rates, or approximations to the values obtained at auction sales:—

Species.	Working circle.	Possible annual yield.	*Value per 100 maunds.		Possible annual revenue.	
			Mds.	Rs. As.	Rs.	Rs.
<b>Timber.</b>						
<i>Sundri</i> ..	I ..	4,405,304	14	0	6,16,743	7,59,762
	II ..	1,173,967	12	0	1,40,876	
	III and V ..	21,425	10	0	2,143	
<i>Gengwa</i> ..	I and II ..	939,101	8	0	75,128	84,221
	III ..	113,285	7	0	7,930	
	V ..	19,382	6	0	1,163	
<i>Passur</i> ..	I and II ..	192,248	12	0	23,070	25,526
	III and V ..	24,559	10	0	2,456	
<i>Dhundal</i> ..	I, II, III and V	36,675	5	4		1,925
<i>Kankra</i> ..	I, II, III and V	131,298	7	0		9,191
<i>Keora</i> ..	I and II ..	217,649	7	0	15,235	16,922
	III and V ..	26,998	6	4	1,687	
<i>Baen</i> ..	I and II ..	105,529	7	8	7,915	8,556
	III and V ..	9,494	6	12	641	
<i>White baen</i> ..	III and V ..	1,840	7	0		129
<i>Amur</i> ..	I, II and III ..	88,901	6	0		5,334
<i>Goran</i> ..	I, IV and V ..	3,084,518	6	0		1,85,071
<i>Math goran</i> ..	IV and V ..	42,246	6	0		2,535
<i>Khalshi</i> ..	I, IV and V ..	11,733	3	8		411
<i>Kirpa</i> ..	IV and V ..	4,670	6	0		280
<i>Other kinds</i> ..	I and II ..	23,570	4	12	1,120	2,181
	III and V ..	26,513	4	0	1,061	
Total possible revenue on timber ..						11,02,044

\* The value of timber of species not previously sold by auction, has been calculated at somewhere between the royalty rate for logs and poles. For species which are expected to yield a larger proportion of logs, the value is nearer to the log rate; for species which are expected to yield a larger proportion of poles, it is nearer the pole rate.

Species.	Working circle.	Possible annual yield.	*Value per 100 maunds.		Possible annual revenue.	
			Rs.	As.	Rs.	Rs.
<b>Fuel.</b>		<b>Mds.</b>	<b>Rs.</b>	<b>As.</b>	<b>Rs.</b>	<b>Rs.</b>
<i>Sundri</i> ..	I and II ..	2,212,895	3	8	77,451	
	III and V ..	26,621	4	0	1,065	
						78,516
<i>Gengwa</i> ..	I and II ..	419,380	2	4	9,436	
	III and V ..	95,457	2	8	2,386	
						11,822
<i>Passur</i> ..	I and II ..	79,277	3	8	2,775	
	III and V ..	23,305	4	0	932	
						3,707
<i>Dhundal</i> ..	I, II, III and V	39,984	3	0		1,200
<i>Kankra</i> ..	I, II, III and V	54,627	3	0		1,639
<i>Keora</i> ..	I, II, III and V	133,194	2	8		3,330
<i>Baen</i> ..	I, II, III and V	169,160	4	8		7,612
<i>White baen</i> ..	III and V ..	64,260	4	8		2,892
<i>Amur</i> ..	I, II and III ..	204,850	4	0		8,194
<i>Goran</i> ..	I and IV ..	883,741	4	0	35,350	
	V ..	20,422	6	0	1,225	
						36,575
<i>Math goran</i> ..	IV ..	5,006	4	0	200	
	V ..	4,206	6	0	252	
						452
<i>Singra</i> ..	I, IV and V ..	161,884	4	0		6,475
<i>Khalshi</i> ..	I, IV and V ..	49,000	3	0		1,470
<i>Kirpa</i> ..	IV ..	1,407	4	0	56	
	V ..	219	6	0	13	
						69
<i>Tora</i> ..	IV and V ..	12,617	2	8		315
Other kinds ..	I, II, III and V	57,569	3	0		1,727
Total possible revenue on fuel						1,65,995

\*The pole rate has been used for *baen* fuel, because the fuel of this species is at present sold at the royalty rate for poles. The pole rate has also been used for the fuel yields of *goran*, *math goran* and *kirpa* from Working Circle V (*vide* paragraph 125 of Chapter VI). The export of fuel of some species was prohibited under the old system of management; the values of such types of fuel have been estimated at the probable rates which will be charged.

163. The following is an estimate of the total possible annual revenue obtainable from the division from all sources. Items other than those dealt with in paragraph 162 have been estimated according to the average revenue realised during the years 1927-28

to 1929-30, excepting for revenue from reptile skins; the figure given for this latter item is the revenue realised in 1929-30, as the sale of these skins was not started until that year.

	Rs.	Rs.
(1) Timber—		
Reserved and protected forests .. ..	11,02,044	
Leased lands ( <i>vide</i> paragraph 33 of Part I) .. ..	12,395	
		11,14,439
(2) Fuel—		
Reserved and protected forests .. ..	1,65,995	
Leased lands ( <i>vide</i> paragraph 33 of Part I) .. ..	2,906	
		1,68,901
(3) Minor produce (leased lands included)—		
<i>Golpatta</i> .. ..	1,71,729*	
Honey and wax .. ..	21,761*	
Lizard, crocodile and snake skins .. ..	10,772	
Other kinds .. ..	15,016	
		2,19,278
(4) Miscellaneous revenue .. ..		46,135
		<hr/>
Total .. ..		15,48,753

\*These are estimates of the immediate possible revenue; under the control prescribed, the possible revenue from these types of produce will gradually increase during the currency of the plan.

### FINANCIAL FORECAST.

164. The financial results of the management of any forest depend in the first case upon the demand for the produce which the forest is capable of yielding. Under the prescriptions of this plan, the export of species whose felling was unregulated during the former system of management, will have to be very much curtailed; on the other hand, the sale of species which were protected during the currency of the last plan, will be capable of a very large expansion. The revenue during the first few years of management, therefore, will depend mainly on the speed with which the markets will absorb new types of timber and fuel in place of the old. To illustrate the extent of the adjustment necessary, the following statement gives a comparison between the possible annual yields under the management now prescribed, and the export under the old type of management as exemplified by the average annual export for the three years from 1927-28 to 1929-30 :—

Species.	Possible yield under the management prescribed.	Average annual export during the years 1927-28 to 1929-30.	Possible expansion + or curtailment necessary—.
<b>Timber.</b>	C. ft.	C. ft.	C. ft.
<i>Sundri</i> .. ..	6,687,398	1,608,539	+5,482,221
<i>Passur</i> .. ..	403,362		
<i>Gengwa</i> .. ..	3,429,659	6,756,824	-3,327,165
<i>Dhundal</i> .. ..	68,232	281,594	-213,362
<i>Kankra</i> .. ..	194,515	347	+194,168
<i>Keora</i> .. ..	489,293	41,360	+447,933
<i>Baen and white baen</i> .. ..	179,788	2,816,629*	-2,636,841
<i>Amur</i> .. ..	165,398	83,998	+81,400
<i>Goran and math goran</i> .. ..	4,169,019	3,510,526*	+658,493
Other kinds .. ..	130,548	231,458	-100,910
Total timber .. ..	15,917,212	15,331,275	+585,937

\*A considerable amount of fuel sold at the royalty rate for poles is included in these figures.

Species.	Possible yield under the management prescribed.	Average annual export during the years 1927-28 to 1929-30.	Possible expansion+ or curtailment necessary—.
<b>Fuel.</b>	C. ft.	C. ft.	C. ft.
<i>Sundri</i> .. .. .	2,674,049	444,954	+2,229,095
<i>Baen</i> and <i>white baen</i> .. .. .	359,108	2,834	+356,274
<i>Amur</i> .. .. .	381,116	1	+381,115
<i>Goran</i> and <i>math goran</i> .. .. .	1,217,834	..	+1,217,834
<i>Singra</i> .. .. .	227,205	} 2,098,005	+655,245
Other kinds .. .. .	2,526,045		
Total fuel .. .. .	7,385,357	2,545,794	+4,839,563

165. With regard to timber, it is evident that the sale of species whose felling was regulated under the former plan, namely, *sundri*, *passur*, *keora*, *kankra* and *amur* should be expanded as much as possible, notably *sundri* whose possible yield is over four times that of the average export during the three years; *goran* is the only other type of produce classified as timber, whose sale may be increased. The most important reduction necessary is that on *gengwa* timber whose export will have to be halved; unfortunately, there is no other timber in the Sundarbans to take its place. *Dhundal* is mainly used for house-posts; the deficiency in this is more than counterbalanced by the excess supply of *passur* and *kankra* which serve equally well for this purpose. The figures for *baen* timber are misleading; the type of produce sold as *baen* poles, but actually used for fuel, has been included in this figure; only the produce classified as *baen* logs is used for timber purposes. The average annual export of *baen* logs during the three years 1927-28 to 1929-30 was 382,862 cubic feet. The excess supply of *keora*, therefore, will more than compensate for the deficiency of *baen* as a timber for cheap planking. In the statement, all types of fuel show possibilities of a large increase in the export, but the figures for *baen* are again misleading. Together with the export of *baen* fuel classified as poles, the average annual export during the three years concerned was 2,436,601 cubic feet; consequently, there is a very large deficiency of this type of fuel. There is also a deficiency of *singra* fuel, the extent of which is not known, because this type has been classified as "other fuel" in the records of the outturn. However, fuel is a necessity, and the markets at which *baen* and *singra* fuel is sold, are not very exacting; there is not much doubt, therefore, that *sundri* and *goran* fuel will be accepted as a substitute.

166. The only type of produce whose export will have to be curtailed and for which there is no substitute is *gengwa* timber; the probability is that the local sale of *sundri*, hitherto not permitted, will counterbalance the loss of revenue on *gengwa* during the first year or so of the plan. Future increases in the revenue will depend mainly on the development of markets for *sundri*. During the years 1879-80 to 1892-93 when there was no embargo on local utilisation, the average export of *sundri* timber was 3,023,928 cubic feet per year. The Sundarbans was not nearly so thickly populated then; consequently, it is not too much to expect that the demand for *sundri* will approximate to the possible yield by the time the currency of this plan

expires. In view of the above, the future financial results of the division may be conservatively forecasted as follows :—

	Rs.
Revenue .. .. .	9,07,515*
Expenditure as per details in paragraph 159 .. .. .	3,37,536
Surplus .. .. .	<u>5,69,979</u>

\*Average revenue realised during the 3 years from 1927-28 to 1929-30.

which, providing royalty rates and standards of value remain unchanged, will develop either gradually or quickly into something like :—

	Rs.
Revenue .. .. .	15,50,000
Expenditure .. .. .	3,80,000
Surplus .. .. .	<u>11,70,000</u>

### Cost of Preparation of the Working Plan.

167. Enumerations and stock mapping for the preparation of this plan were started on the 27th November 1926, and were continued until the 24th June 1927, when the field work was closed down for the rains. Work was resumed on the 22nd September 1927, and finished on the 31st March 1928. The field work, therefore, took 13 months 6 days to complete. The compilation of the plan took much longer; it was started during the rains of 1927, resumed after the field work was finished, and continued until the date of the submission of the plan. The cost incurred, including both direct and indirect expenditure, was as follows :—

	Rs.	Rs.	Rs.
1. Expenditure charged to 52A—II(d) (Working plans) :—			
Pay of line cutters and enumerators .. .. .		3,747	
Wages of coolies .. .. .		6,173	
Wages of boat crews .. .. .		1,919	
Maps—			
Pay of draftsman .. .. .	3,057		
Cost of printing .. .. .	4,619		
		<u>7,676</u>	
Pay of clerks, office peons, etc. .. .. .		1,427	
Mathematical instruments, and other stores, etc.		3,212	
		<u>3,212</u>	24,154
2. Expenditure charged to other heads :—			
Pay and allowances of gazetted officers (including those of writer) .. .. .		40,445	
Pay and allowances of subordinate officers and clerks employed on working plan work .. .. .		13,289	
Pay of permanent draftsman .. .. .		1,366	
Pay of crews of departmental launches and boats, etc. .. .. .		10,524	
Rents, rates and taxes .. .. .		457	
Estimated share of repairs to launches and boats, and the consumption of fuel and stores by these craft .. .. .		10,000	
		<u>76,081</u>	
Total .. .. .		<u>1,00,235</u>	

The total area of the Sundarbans forest is 1,582,581 acres; the cost therefore works out to an average of approximately one anna per acre.

## CHAPTER X.

## SUMMARY OF THE PRESCRIPTIONS.

168. The treatment for each working circle is given in the form of executive orders in the following paragraphs, namely—Working Circle I, paragraphs 66, 67, 68 and 71; Working Circle II, paragraph 86; Working Circle III, paragraph 101; Working Circle IV, paragraph 117; and Working Circle V, paragraph 126. If the instructions in these paragraphs are observed, the rest of the prescriptions for the working circles will automatically be followed. The following is a list of the prescriptions to be observed and the suggestions made in the plan :—

**Preliminary Prescriptions for the Whole Division.***(Chapter I.)*

	Paragraphs.
(1) Distribution and boundaries fixed for the following—	
Ranges .. .. .	21 and 22
Working circles .. .. .	25
Felling series .. .. .	28
(2) Exploitable diameters fixed for all types and qualities of forest for the following species—	
<i>Sundri, gengwa, passur, dhundal, kankra and white baen</i> .. .. .	39
<i>Keora and baen</i> .. .. .	40
(3) Period for which prescriptions have been made—	
Twenty years .. .. .	43
Prescriptions liable to revision after 10 years, and in the case of <i>goran</i> (Working Circle IV), after 5 years .. .. .	44

**Working Circle I.***(Chapter II.)*

(1) Method of treatment—	
System—"Selection <i>cum</i> improvement" .. .. .	54 and 55
Felling cycle—20 years .. .. .	56
Annual yield prescribed by area, with a check on the volume outturn of timber from <i>sundri, gengwa</i> and <i>passur</i> trees of 6 inches in diameter and over .. .. .	63, 64 and 68
(2) Fellings—	
Method and rules for marking .. .. .	66
Felling and coupe rules .. .. .	67
Application of volume check .. .. .	68
Tabular statement of fellings to be made .. .. .	69
Subsidiary fuel thinnings .. .. .	71

**Working Circle II.***(Chapter III.)*

(1) Method of treatment—	
System—"Selection <i>cum</i> improvement" .. .. .	80
Felling cycle—30 years .. .. .	81
Annual coupes prescribed by area .. .. .	84

	Paragraphs.
(2) Fellings—	
Felling, marking and coupe rules .. .. .	86
Tabular statement of fellings to be made .. .. .	87

### Working Circle III. ✓

#### (Chapter IV.)

(1) Method of treatment—	
System—Unregulated felling confined to annual coupes .. .. .	94
Felling cycle—40 years .. .. .	95
Additional fellings of mature trees .. .. .	96
Special rules for <i>keora</i> and <i>baen</i> .. .. .	97
(2) Fellings—	
Felling and coupe rules .. .. .	101
Tabular statement of fellings to be made .. .. .	102

### Working Circle IV.

#### (Chapter V.)

[This is the *goran* working circle super-imposed on Working Circles I, II and III, *vide* paragraphs 24 and 25.]

(1) Method of treatment—	
System—Fellings to be supervised and confined to annual coupes.	
Some withes to be kept on each rootstock .. .. .	110
Felling cycle for Series Nos. 1 to 5—16 years .. .. .	112
Felling cycle for Series Nos. 6 and 7—20 years .. .. .	113
(2) Fellings—	
Felling and coupe rules .. .. .	117
Tabular statement of fellings to be made .. .. .	118

### Working Circle V.

#### (Chapter VI.)

(1) Method of treatment—	
Revenue station and permit system as before .. .. .	123
Felling for export in large boats to be confined to each compartment in turn on a cycle of 40 years in Felling Series 1, and to areas due shortly for colonization in Felling Series 2 .. .. .	124
Other regulations regarding the felling of certain types of produce, and the preservation of the crop on certain new formations .. .. .	125
(2) Fellings—	
Summary of rules to be observed and fellings to be made .. .. .	126

### Prescriptions Common to all working Circles.

(1) <i>Golpatta</i> —	
Scheme for the forests of the Khulna District— <del>5</del> cutting series, with a cutting cycle of one year .. .. .	129
Cutting and coupe rules .. .. .	130
Scheme for the forests of the 24-Parganas District—Extraction limited to boats not exceeding 300 maunds .. .. .	131
(2) Honey and wax—	
Extraction to be confined to the season, 1st April to 15th June, and sanctuaries to be observed in each range .. .. .	133
Rules for collecting .. .. .	134

## Paragraph.

(3) Other types of minor produce—		
On payment of royalty rate, passes to be issued without restriction ..		135
(4) Regulation of rights and concessions—		
Chittagonian fishermen settling on the sea-face still to pay compensation charged by the head .. .. .		137
(5) Floating craft—		
Rules for their repair .. . . .		140
(6) <i>Bharani khals</i> —		
Bainsanta and Cheilabogi <i>khals</i> —Patrols to cut overhanging trees each year. <i>Bharani</i> between Sarankhola Revenue Station and Bogi <i>khals</i> to be improved if possible .. .. .		141
(7) The system of permits and entry passes—		
Entry passes to be issued for boats proceeding to coupes on payment of a small fee. Not a source of revenue. Fee to be deducted from price of permit at coupe .. . . .		145
The issue of permits at revenue stations in the Basirhat and Namkhana Ranges to be continued .. . . .		146
Entry pass system need not be introduced if <i>goran</i> and <i>golpatta</i> extraction is not confined to coupes. Rules for the issue of permits, entry passes, etc., given in Appendix XII .. .. .		148
(8) The collection of data and upkeep of records—		
Volume tables—Officers on coupes to continue to measure volumes of felled trees whenever they have the opportunity .. .. .		150
Control forms—Type of forms to be used . . . . .		151
Forest Journal—To be kept in duplicate on loose leaf system .. . . .		152
Preparation and maintenance of maps—Stock maps of Working Circles I and II to be gradually improved and corrected. Present stock maps to be carefully preserved .. . . .		153

### Forests outside the Working Circles.

(1) Leased lands—		
As before, permits and right of way passes to be issued according to the notified rules in force .. . . .		147
[No other forests outside the working circles.]		

### Suggestions.

(1) Sowings, plantings, etc.—		
Small experimental sowings and plantings in blanks advised .. . . .		139
(2) Water-supply—		
Construction of fresh-water tanks on sandy areas near the sea-face recommended .. . . .		142
(3) Buildings—		
The construction of suitable quarters for range officers recommended .. . . .		143
(4) Rate of growth—		
Suggestions regarding what information is still necessary. Increment figures for the average tree are more important than increment figures per acre .. . . .		149



## APPENDIX I.

List of vernacular names of the more common trees or other plants, and various local terms used in the plan.

- ✓ **Amur**: *Amoora cucullata*, a small tree.  
 ✓ **Baen**: *Avicennia officinalis*, a large tree.  
**Ban-Bakul**: *Cyclostemon assamicus*, a small tree.  
**Ban-Jam**: *Eugenia fruticosa*, a small tree.  
**Ban-Nebu**: *Paramignya longispina*, a thorny undergrowth. ✓  
**Batul**: *Sapium indicum*, a small tree. ✓  
 ✓ **Bhadal, or Bhaila**: *Afzelia bijuga*, a medium sized tree.  
 † **Bharani**: A term used in the Eastern Sundarbans, for a *khal* which connects one large river with another. nat  
 ✓ **Bhola**: *Hibiscus tiliaceus*, a scrambling and semi-climbing liana.  
 † **Bil**: A damp, or water covered depression. ✓  
 † **Boali**: Literally, a man of the forest; a term used to denote all woodcutters. ✓  
**Boali-Lota**: *Sarcolobus globosus*, a climber; the fruit is called *boali-phol*. ✓  
 † **Bund**: A dyke or embankment. ✓  
 † **Char**: A shoal or bank of mud or sand. In the area statements, *char* means land without tree growth, which is below the usual high tide level. ✓  
 † **Chitta**: A more phonetical mode of spelling would be *chhita*; a local term used for thin withes of *goran* and other woody species, or for split bamboo. *Chittas* are used for fencing, wicker-work, fixing thatched roofs, etc. ✓  
 † **Dabba**. A pole laid across a boat for slinging logs or *jhools* floating on either side. ✓  
**Dakor or Dabur**: *Cerbera Odollam*, a medium sized tree.  
 † **Dharma**: Matting made of split bamboo, or of reeds. ✓  
**Dhundal**: *Carapa obovata*, a small tree.  
 † **Duania or Doania**: Literally, two mouths; a term used in the Western Sundarbans, for a *khal* which connects one large river with another. ✓  
**Gab**: *Diospyros embryopteris*, a medium sized tree.  
 † **Gamastha**: The headman of a party of *Sundri* timber cutters from Barsakati. ✓  
 † **Gang**: A medium sized water channel of about 300 to 1,000 yards in width; but, owing to continual scouring or silting, often the word is found used with the proper names of channels of greater, or less width. ✓  
 † **Garjan**: Generally *Rhizophora conjugata*, but the same name also applies to *Rhizophora mucronata*. Both medium sized trees.  
 ✓ **Gengwa**: *Excoecaria Agallocha*, a fair sized tree.  
 † **Gengwa mathal**: Widely spaced pure *gengwa* forest, without any undergrowth; usually, the trees are in clumps of coppice growth, 15 feet to 30 feet in height. *Gengwa mathals* occur, as a rule, on low ground levels in the moderately salt-water forests. ✓  
**Gila**: *Entada scandens*, syn. *E. Pursætha*, a large and woody climber. ✓  
 † **Golpatta**: *Nipa fruticans*, a palm with a soboliferous stem.

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**Goran** : *Ceriops Roxburghiana*, a small tree or shrub of coppice-like growth.

**Goria** : *Kandelia Rheedii*, a small tree.

**Hantal** : *Phoenix paludosa*, a small gregarious palm.

**Hargoza** : *Acanthus ilicifolius*, a small prickly leaved shrub. 5.

**Hodo** : *Acrostichum aureum*, a rigid tufted fern undergrowth. ✓

**Hogla** : *Typha elephantina*, a large bulrush. The same name also applies to *Typha angustata*.

**Jhara** : Timber which has sunk beneath the mud and become naturally seasoned in the same way as Bog Oak. - Such timber is darker in colour, harder and more durable than air seasoned timber. *Sundri* and *passur*, and occasionally *kankra*, *dhundal* and *amur* will season in this way.

**Jhinook** : *Cyrena bengalensis*, an estuarine bivalve. ✓

**Jhool** : Floats used on either side of a boat, in order to steady it. ✓

**Jir** : *Ficus retusa*, a medium sized tree, or climber.

**Jongra** : *Cerithium telescopium*, a mollusc with a conical shaped shell. ✓

**Kankra** : *Bruguiera gymnorhiza*, a medium sized tree.

**Karanj or Keranj** : *Pongamia glabra*, a large tree, generally of spreading habit.

**Keora** : *Sonneratia apetala*, a large tree generally of spreading habit.

**Kewa-Kanta** : *Pandanus odoratissimus*, syn. *P. fascicularis*, a gregarious screw pine undergrowth. ✓

**Khal** : A small sized water channel. Generally applied to all channels of less than about 300 yards in width, but owing to scouring out, the word *khal* may be found used with the proper names of larger channels. ✓

**Khalshi** : *Ægiceras majus*, a small tree or shrub of coppice like growth.

**Khartchi** : Small poles lashed in an upright position to the side of a boat, in order to keep the cargo properly fixed in position. ✓

**Kirpa or Kripa** : *Lumnitzera racemosa*, a small tree.

**Kostura** : *Ostrea gryphoides*, a type of oyster. 6.

**Kumia** : *Barringtonia racemosa*, a medium sized tree.

**Maidan** : In the area statements, this term refers to the sandy grassy blanks, found near the sea; it also includes sand dunes. ✓

**Mallam or Mallum** : Planks laid along on top of the *gunwale* of a boat, and roughly caulked with mud, in order to increase the freeboard. ✓

**Manjhi** : Literally, the helmsman of a boat, but commonly used to denote the headman of a woodcutting party. ✓

**Mara khal** : A blind *khal*, which gradually breaks up into smaller *khals* and is lost in a drainage area; as opposed to *bharani* and *duania khals*, which connect one large watercourse with another. ✓

**Math** : Large stretches of shrubby growth, from 2 feet to 4 feet high; i.e., *goran* *math* means an area of shrub *goran* with no admixture of taller growth. ✓

**Math-goran** : *Ceriops Candolleana*, a small tree. ✓

**Mathal** : See *Gengwa mathal*.

**Nadi or Nodi** : A river of large width. Very often, the word is found used with the proper name of a comparatively small channel; probably because, at one time, it was a much larger stream. ✓

**Nal** : *Arundo karka*, syn. *Phragmites karka*, a tall reed-like grass. ✓

**Nona-Jhao** : *Tamarix gallica* var. *indica*, an evergreen shrub or bush. 5.

**Ora** : *Sonneratia acida*, a medium sized tree.

**Parash or Paresh :** *Thespesia populnea*, a small tree.

**Passur or Passar :** *Carapa moluccensis* var. *gangetica*, a fair sized tree.

**Pukka Sundri :** *Sundri* of slow growth, which contains a large proportion of heartwood, is darker in colour, and more durable than *sundri* of quicker growth. The same term *pukka* is applied also to *passur* of slow growth.

**Reserved species :** Only *sundri* and *passur* have been notified as reserved trees (*vide* paragraph 32 of Part I); but, in the histories of each compartment given in Appendix III, it has been found convenient to extend this term to *kankra*, *amur* and *keora*, whose fellings within the forests have hitherto been restricted in the same way as the fellings of *sundri* and *passur*.

**Sada Baen :** A word coined by the forest subordinates for *Avicennia alba*, a small or medium sized tree. The tree is generally called *baen* by the local population, who make no distinction between this tree and *Avicennia officinalis*.

**Satali-gach :** *Ægialitis rotundifolia*, a single stemmed shrub or small tree.

**Shulas :** Pneumatophors or woody growths which sprout up above the ground from the lateral roots of many Sundarbans trees, notably *sundri*, *passur*, *dhundal*, *keora* and *baen*. The *shulas* of *sundri* resemble inverted tent pegs; those of *keora* and *baen* are more cylindrical in shape. *Shulas* are longer in damp areas than they are in drier places. The height of the *shulas* is generally indicative of the maximum high tide level.

**Singra :** *Cynometra ramiflora*, syn. *C. mimosoides*, a small tree of spreading habit.

**Sundri :** *Heritiera minor*, syn. *H. fomes*, a fair sized tree.

**Sundri-lota :** *Brownlowia lanceolata*, a gregarious withy shrub.

**Tiger Fern :** The English equivalent of *hodo*.

**Tintul :** *Tamarindus indica*, a large tree.

**Tora :** The same as *satali-gach*.

**Wilu :** *Saccharum cylindricum*, syn. *Imperata arundinacea*, a tough grass.

**White Baen :** European equivalent of *sada baen*.

**Wild Lemon :** European equivalent of *ban-nebu*.

