

A CONTRIBUTION TO THE FOREST BOTANY OF
THE ANGUL DIVISION IN ORISSA STATE

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INTRODUCTION

Literature on Botanical studies of Angul Division goes back to 1925 when Haines (1925) prepared the flora of Bihar and Orissa and included the area in the 'Southern tract'. According to Mooney (1933) a larger part of the area comes in the 'Sal region' represented by dry type Sal forests. In his subsequent work Mooney (1939, 1950) contributed further to the flora of the region. The present authors have given an account of the forests of this division. The investigation was conducted during the winter of 1961-62 when both the authors were on the staff of the Central Botanical Laboratory, Allahabad.

LOCATION AND PHYSICAL FEATURES

Angul Division lies approximately between 20. 48' and 21. 16' N latitudes and 84. 7' and 85. 2' E longitudes.

The larger part of the area comprises of hills and valleys with a number of rocky ravines. Level grounds with flat or undulating topography are also found near the Angul town and Talcher. The slopes of the hills are generally steep and occasionally precipitous. The elevation generally varies bet-

ween 150 m to 750 m above the sea level. However, the lowest elevation point in the area has been recorded in the Forest Working Plan as 120 ft. (36.58 m) and the highest 2,742 ft. (835.76 m).

Drainage in the area is provided by the river Mahanadi with the aid of a number of nullahs, the largest being the 'Halua nala' in the Raigoda range.

GEOLOGY AND SOIL

The main rock system in the area comprises of granite, quartzite and sandstones. Shales, phyllites, siliceous clay slates and especially mica- and haematite-schists are also common (Haines 1925).

The soil is mostly ferruginous loam ('morrum'), greyish brown to red in colour and coarse in texture. It is shallow on the top of the hills and deeper on the lower slopes. The valleys have deep fertile soil. Clayey soil is also seen at places. 'Kankar' formations (nodular limestone) giving rise to impermeable clay are occasionally encountered especially at the bottom of some of the hills and near nullahs.

CLIMATE

The area possesses a monsoon climate with a short mild winter and long hot summer. The rainy season starts in the third week of June and remains active up to the middle of September. The rainfall data as recorded in the Forest Working Plan (Jee 1959) is given in table I for three representative localities.

The mean maximum temperature is 90°F (32.2°C) and the mean minimum temperature is 69°F (20.6°C) for Angul (Haines 1925).

BIOTIC FACTORS

The inhabitants of the area are entirely dependent on the neighbouring forests for timber, fuel and fodder supply. This results in the lopping and cutting of forest trees and grazing and browsing of tree seedlings along with grasses and

forbs, ultimately affecting the normal development of the vegetation. Owing to cultivation which is mainly of the dry type, some of the valleys are almost completely devoid of natural vegetation. Large areas have been clear-felled for raising teak plantations. The effect of intense biotic pressure is well exemplified by the barren areas especially near the Angul town.

TABLE I
Average Rainfall in centimetres

Months	Localities		
	Angul (Average for 16 years)	Tikerpura (Average for 16 years)	Raigoda (Average for 10 years)
January	1.01	1.78	1.65
February	3.80	7.49	4.03
March	1.44	0.99	4.88
April	2.46	2.16	5.35
May	5.89	2.08	11.25
June	19.05	8.20	25.94
July	35.68	46.05	33.58
August	30.65	19.05	28.47
September	21.20	61.13	17.50
October	9.70	10.59	11.63
November	3.23	0.13	0.75
December	0.13	...	0.13
Total	134.24	159.65	145.16

VEGETATION

The present studies were made by the transect method. Twenty quadrats (each 6 x 6 sq. m) were marked along a transect running across the foothill to the hill top in representative localities and the occurrence of Sal (*Shorea robusta* Gaertn. f.) was recorded. The size of the quadrat was arrived at by species area curve method (Oosting 1958).

On the basis of the frequency occurrence of Sal the forests of this division could be distinguished into the following types: (i) Sal forest--where the frequency of Sal is more than 60 per cent. (ii) Mixed Sal forest - where the frequency of Sal is between 30 to 60 per cent. (iii) Miscellaneous forest - where the frequency of Sal is less than 30 per cent or it is altogether absent.

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The lower slopes of the hills are invariably covered with thick clumps of bamboos especially in the Miscellaneous forests. Thus these forests provide large amount of raw material for paper industry.

SAL FOREST

This type of forest is rather restricted in distribution being found at Raigoda and Bolong or in small scattered patches in the interior of the division. The hill slopes under these forests are moderate and the soil is not too shallow. The aspect is cooler (e. g., slopes facing northwest direction).

The principal associates of Sal in these forests are: *Adina cordifolia* Hk.f., *Alangium salviifolium* (Linn.f.) Wang, *Albizia odoratissima* Benth., *Anogeissus latifolia* Wall., *Anthocephalus cadamba* Miq., *Bambusa arundinacea* Willd., *Careya arborea* Roxb., *Casarea tomentosa* Roxb., *Clerodendrum viscosum* Vent., *Dendrocalamus strictus* Nees, *Dillenia pentagyna* Roxb., *Diospyros melanocylon* Roxb., *Holarrhena antidyenterica* Wall., *Lannea coromandelina* (Houtt.) Merr., *Meliusa velutina* Hk.f. & T., *Protium serratum* (Wall. ex Colebr.) Engl., *Pterocarpus marsupium* Roxb., *Randia uliginosa* DC., *Stereospermum* sp., *Syzygium cumini* (Linn.) Skeels and *Terminalia tomentosa* Bedd.

Out of these species *Adina cordifolia*, *Anogeissus latifolia*, *Careya arborea*, *Lannea coromandelina* and *Protium serratum* are more abundant on the upper slopes of the hills while the lower slopes are populated by *Alangium salviifolium*, *Albizia odoratissima*, *Dillenia pentagyna*, *Terminalia tomentosa* and *Bambusa arundinacea*. *Terminalia* is frequent sometimes on the upper slopes also.

The common climbers are: *Butea superba* Roxb., *Bauhinia retusa* Ham., *B. vahii* W. & A., *Combretum decandrum* Roxb., *Milletia auriculata* Baker and *Zizyphus oenoplia* Mill. Species of *Smilax* and *Dioscorea* are also found.

Ixora parviflora Vahl. is abundant especially on the lower slopes. In these forests Sal is much more abundant on

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the middle slopes. Its regeneration is also frequent on the middle and lower slopes.

MIXED SAL FOREST

This type is well distributed in the area and is comparatively open. Typical examples are some of the forests in the Majhpara and Baghmunda blocks. Besides the principal associates of Sal enumerated in the first type, following species are also frequent: *Cassia fistula* Linn., *Cleistanthus collinus* Benth., *Elaeodendron roxburghii* W. & A., *Embluca officinalis* Gaertn., *Flacourtia indica* (Burm. f.) Merr., *Madhuca indica* Gmel., *Morinda tinctoria* Roxb., *Terminalia arjuna* W. & A. and *Woodfordia fruticosa* (Linn.) Kurz. *Dalbergia latifolia* Roxb. is also found at some places.

Here again, *Anogeissus latifolia*, *Careya arborea*, *Lannea coromandelina*, *Terminalia bellirica* Roxb. and *T. tomentosa* are abundant on the upper slopes while the lower slopes are mainly covered with *Alangium salviifolium*, *Casarea tomentosa*, *Cochlospermum religiosum* (Linn. f.) Alston, *Diospyros melanocylon*, *Embluca officinalis*, *Madhuca indica*, *Meliusa velutina*, *Randia uliginosa* and *Bambusa arundinacea*.

The proportion of Sal trees again increases on the middle slopes. *Dendrophthoe* sp. is common on the trees. The climbers are more frequent on the middle and lower slopes. Shrubs of *Moghania* are abundant.

MISCELLANEOUS FOREST

A larger part of the area is covered with miscellaneous forests growing usually on steep and warmer slopes. *Dendrocalamus strictus* is a common feature flourishing well on the steep slopes. Sal is either absent or present in very small amount.

The common species in these forests are: *Alangium salviifolium*, *Albizia chinensis* (Osbeck) Merr., *Alstonia scholaris* Br., *Anogeissus latifolia*, *Anthocephalus cadamba*, *Bauhinia retusa* Spreng, *Butea monosperma* Taub., *Callicarpa arborea*

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Roxb., *Careya arborea*, *Cleistanthus collinus*, *Clerodendrum viscosum*, *Cochlospermum religiosum*, *Dalbergia latifolia*, *Dillenia aurea* Sm., *D. pentagyna*, *Diospyros melanoxylon*, *Ficus hispida* Linn., *F. religiosa* Linn., *F. tjakela* Burm., *Gardenia latifolia* Ait., *G. gunnifera* Linn. f., *Grewia elastica* Royle, *G. villosa* Vahl, *Helicteris isora* Linn., *Lagerstroemia parviflora* Roxb., *Lamnea coromandelina*, *Limonia acidissima* Linn., *Malluca indica*, *Melia composita* Willd., *Mitragyna parviflora* (Roxb.) Korth., *Ougenia dalbergioides* Benth., *Protium serratum*, *Spondias mangifera* Willd., *Sterculia urens* Roxb., *S. villosa* Roxb., *Stereospermum suaveolens* DC., *Strychnos nux-vomica* Linn., *Terminalia bellirica*, and *T. tomentosa*. In moist localities especially near streams *Bambusa arundinacea* is abundant. *Acacia concinna* DC., *Combretum decandrum*, *Dioscorea alata* Linn., *D. pentaphylla* Linn., and *Zizyphus oenophia* are the common climbers in these forests.

A relatively moist type and much disturbed forest where Sal is altogether absent, was studied at Purnakote. The upper slope of the hill in this case is inhabited by *Anogeissus latifolia*, *Ficus religiosa*, *Lamnea coromandelina*, *Melia composita*, and *Strychnos nux-vomica*. On the lower slopes *Alangium sal-vifolium*, *Cleistanthus collinus*, *Limonia acidissima*, *Melia composita* and *Bambusa arundinacea* are quite frequent. *Abrus precatorius* Linn., *Acacia concinna*, *Passiflora foetida* Linn., and species of *Dioscorea* are the common climbers.

At the bottom of the hillock where grazing is most intense and the area is almost free of any good size tree, large number of saplings of the following species were noted: *Alangium sal-vifolium*, *Casuarina tomentosa*, *Diospyros melanoxylon*, and *Strychnos nux-vomica*.

Besides these forest types the 'kanhar' formations mainly on the level ground support a thin sparse and stunted stand of the following species: *Acacia catechu* Willd., *A. leucophloea* Willd., *Cleistanthus collinus*, *Randia uliginosa*, *Strychnos potatorum* Linn. f. and *Zizyphus mauritiana* Lamk. The ground

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flora here is predominantly of overgrazed grasses and forbs. *Strychnos potatorum* is very common on the calcareous sides of the river Mahanadi.

TEAK PLANTATION

At many places in the division teak (*Tectona grandis* Linn.) plantations have been raised on the middle and lower slopes of the hills after clear-felling the forests. Some of these plantations are well over fifteen years of age. Shrubs of *Moghania paniculata* (Wall.) Li, *M. chaparr* (Ham. ex Benth.) O. Kuntz, *M. bracteata* (Roxb.) Li and *Mallotus philippinensis* Miell. are frequent under these plantations. Regeneration of the following species is abundant: *Anogeissus latifolia*, *Cassia fistula*, *Dendrocalamus strictus*, *Diospyros melanoxylon*, *Dillenia pentagyna*, *Lamnea coromandelina* and *Randia uliginosa*. Under these plantations undergrowth is very dense.

Some other undershrubs, herbs, grasses and climbers occurring in these forests and under teak plantations are listed below. It may also be noted that the abundance of the shrubs and herbs increases in the mixed Sal forests and miscellaneous forests and is maximum under teak plantations.

Abutilon indicum G. Don., *Achyranthes aspera* Linn., *Azadirachta indica* Linn., *Aerva sanguinolenta* (Linn.) Blume, *Andropogon paniculata* Nees, *Aristida adscensionis* Linn., *A. setacea* Retz., *Arundinella setosa* Trin., *Asparagus racemosus* Willd., *Blumea oxydonta* DC., *Boerhaavia diffusa* Linn., *Calotropis procera* R. Br., *Celastrus argentea* Linn., *Chrysogonon montanum* Trin., *Crotalaria albida* Heyne, *Curcuma longa* Linn., *Cyperus difformis* Linn., *Cyathocline lyrata* Cass., *Dicellaeanthus montanus* T. Anders, *Duranta repens* Linn., *Echinopogon gangeticum* DC., *Echinopogon colonum* Link., *Eragrostis tenella* R. & S., *Euphorbia granulata* Forsk., *E. hirta* Linn., *Euphorbia suaveolens* Poit., *Ipomoea turpethum* R. Br., *Iselema* Hack., *Lepidagathis incurva* D. Don., *Mimosa pudica* Linn., *Oplismenus burmannii* Beauv., *Panicum* sp., *Peristrophe polyculata* Nees, *Phalopsis parviflora* Willd., *Pogostemon*

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plectranthoides Desf., *Rotula indica* Koehn., *Scindapsus officinalis* Schott., *Sporobolus diander* Beauv., *Tephrosia purpurea* Pers., *Triumfetta neglecta* W. & A., *Urena lobata* Linn. and *Xanthium strumarium* Linn. The Forest Department has tried to raise *Rauwolfia serpentina* Benth. and *R. tetraphylla* L. (syn. *R. canescens* L.) but the attempt is not very successful.

DISCUSSION

The forests of the Angul division lie almost at an extreme end of the Sal belt of India (in the Southern Sal Subregion; Bhatnagar 1961) and are more or less in continuation with the forests covering Madhya Pradesh hills. According to Champion's (1933) classification of Sal types which is mainly based on rainfall, the Sal forests of this region come under the 'moist Sal type'.

A perusal of the foregoing description of the forests supports Haines (1925) statement that these forests present a somewhat heterogeneous assemblage of trees of damper and drier conditions. The forests appear to be, however, of the tropical moist deciduous type. The outward resemblance of the forests at some places to the dry deciduous type seems to be due to the intense biotic pressure coupled with some edaphic factors. These factors are already known to change the physiognomy of vegetation (Puri 1960).

A study of the distribution of Sal in these forests is rather interesting. It is seen growing best on loamy soil on the middle slopes of the hills which have comparatively moderate gradient. Though Sal trees ascend to some extent on the upper slopes also their quality and abundance are considerably reduced. The trees become smaller in size and appear to be stunted on the ridges. These upper slopes are much steep and have a shallow covering of soil. Moreover, steep slopes are thoroughly drained off and have comparatively a low per cent of soil water (Bhatnagar 1961). Thus conditions here do not allow good growth of Sal. The lower slopes which have deep moist and fertile soil (conditions cited by Bhatnagar (1961) as

being favourable for good Sal forests) are mostly covered with thick clumps of bamboos and evergreen shrubs which inhibit the establishment of Sal seedlings and thus Sal is ousted from the lower slopes. The problem of regeneration of Sal at Raigoda, Angul, has been briefly discussed by Osmaston (1934) who has described a technique for felling of bamboos and clearing the area in order to enable the existing regeneration to develop.

The existence of the mixed Sal forest appears to some extent to be due to biotic pressure resulting in gradual degradation of originally rich Sal forests, the latter being now confined to comparatively interior parts of the area. This disturbance might have also led to variations in the climatic (microclimatic) and edaphic factors. A change in the vegetation developed even on the same lithology is expected due to slight variation in any of the climatic factors or intensity of biotic operation (Pandeya 1962). The miscellaneous forests might have developed by a further degradation of mixed Sal forests or more probably the peculiar edaphic conditions unfavourable to Sal may be responsible for their existence.

The plant community developed on the 'kankar' formations is purely edaphic in nature.

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SUMMARY

The forests of the Angul Division (District Dhenkanal) Orissa are of the tropical moist deciduous type and lie at an extreme end of the Sal belt of

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India. The soil is mostly ferruginous loam. The area possesses a monsoon climate. On the basis of the frequency occurrence of Sal trees the forests could be distinguished into the following types :

- (i) Sal forest where the frequency of Sal as determined by 6×6 m quadrats marked along a transect running across the foot hill to the hill top is more than 60 per cent,
- (ii) Mixed Sal forest where the frequency of Sal is between 30 to 60 per cent, and

- (iii) Miscellaneous forest where the frequency of Sal is below 30 per cent or it is altogether absent. Besides the above types the teak plantations, raised by the Forest Department after clear-felling the areas, have also been described.

Botanical composition of each of the four types is given in the text.

Sal is seen growing best on loamy soil in the mid region of the slopes of the hills.

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