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Ecological Study of Coconut Plantations of Ganjam Coast, Odisha, India

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Abstract

Coconut is the most prevalent plantation crop in India. An ecological study was conducted to determine the morphological parameter, biomass and moisture content of different parts of coconut palm i.e., coconut leaf, mid-rib of leaf, leaflet and different parts of nut in costal Ganjam District of Odisha. Many research experiments are in progress for the increase of yield of this crop and development of post harvest products that will improve the socio-economic status of the farmers who cultivated coconut palm.

Keywords: Coconut Plantation, Biomass, Moisture Content, Ganjam District.

Introduction

Coconut is primarily a small holders going back to more than 3000 years. It is now cultivated throughout humid tropics (Dhanapal, 2002). Coconut palm is one of the most important sources of vegetable oil in the world. This plant is known as 'wonder plant' yielding many products. The coconut is a member of the family Arecaceae (Palmaceae). It is only the accepted species in the genus Cocos and is a large palm, grow up to 30 m tall, with pinnate leaves 4-6 m long, and pinnae 60-90 cm long, old leaves break away minimally, leaving the trunk smooth. Coconut is the most resourceful among the world's 2,700 species of palm; it provides edible and industrial oil, protein rich milk, invigorating water, timber fibre, roofing and matting materials and a number of products from the shells. Each part of the tree is being utilized for some point or other. Due to versatile uses and affinity to India culture, coconut is rightly called "the tree of heaven" or "*Kalpavriksha*". The coconut palm (*Cocos nucifera* L.) is one of the important crops of the humid tropics and primarily small holders crops (Dhanpal 2002). It provides a range of useful products such as food, fuel and timber. Coconut plantation in Odisha enclosed an area of 51,000 ha producing 275.8x106 nuts and the productivity is 5408 nuts per hectare. In Ganjam district, 7575 ha area is under coconut plantation and produces 497.35x105 nuts and the productivity is 6566 nuts per hectare. Much of the coastal areas of Odisha are covered with coconut plantation along with other vegetations such as cashew (*Anacardium occidentale* L.), beefwood (*Casuarina equisetifolia* L.) and screw pine (*Pandanus odorifer* (Forssk.) Kuntze).

Based on structure coconut is broadly classifies in to tall palms and dwarf palms.

Tall palms are sometimes referred to as var. typica. They grow to height of 20-30 m and are slow maturing, first flowering 6-10 years after planting.

1. The tall are sturdy, take 8-10 years for bearing and steady bearing by 13-14 years.
2. Economic life is 60 year; life span extends to 80-100 years.

Dwarf palms are referred as var. nana. They are short saturated, slow growing, leaves small and bearing in third or fourth year. They are in full bearing in ninth year and have short productive life 30-35 years. The fruits are small and colour varies from different colours.

A lot of work has been done on different aspects of the coconut plantation and different parts of the coconut. Kumar & Rajgopal (2007) worked on the drought management in the coconut garden through moisture conservation. The cardio protective effect of tender coconut water was analyzed by the Anurag *et al.* (2007). The potential of coconut in manufacturing Ayurvedic medicines has been elaborated by Monohar (2006). Much work has been done on the intercropping with coconut plantation in different parts of the country (Thomas *et al.* 2007; Medda *et al.*

2008; Ghosh *et al*.2007). Dash *et al.* (2007) evaluated the coconut hybrids and verities for tender nut under Orissa condition.

Study Site and Climate

Study Area

Ganjam one of the 30 districts of Odisha in the eastern part of India, lies between 18° 58´ N to 20° 17´ N latitude and 84° 06´ E to 85° 11´ E long. Coastal area of Ganjam (Fig.1) is bounded by Andhra Pradesh in the south and Puri district of Odisha in the north, in the east it is bounded by the Bay of Bengal.

Sites

For the present work three coconut plantation sites in the coastal Ganjam district were selected, namely Gopalpur, Batachatrapur and Golabandha, that are situated about 15 km, 22 km and 15.4 km from Berhampur city, respectively. Gopalpur (site 1) is 2 km away from the sea whereas Batachatrapur (site 2) 3-4 km and Golabandha (site3) 2-3 km from the sea.

Soil

Analysis of soil samples collected from different sites. The soil ph range from 7.2-8.7, organic carbon varied from 0.60-1.20%, water holding capacity from 21%-35%and the soil temperature 20 ^{0}C to 3 4 ^{0}C. The soil texture showed that the soil was silt-clay-loam and silt-sandy-loam. Coconut palm grows on sandy, saline, wastelands and marshy land on the bounds.

Fig.1. Map showing the coastal Ganjam, Insets are India and Odisha

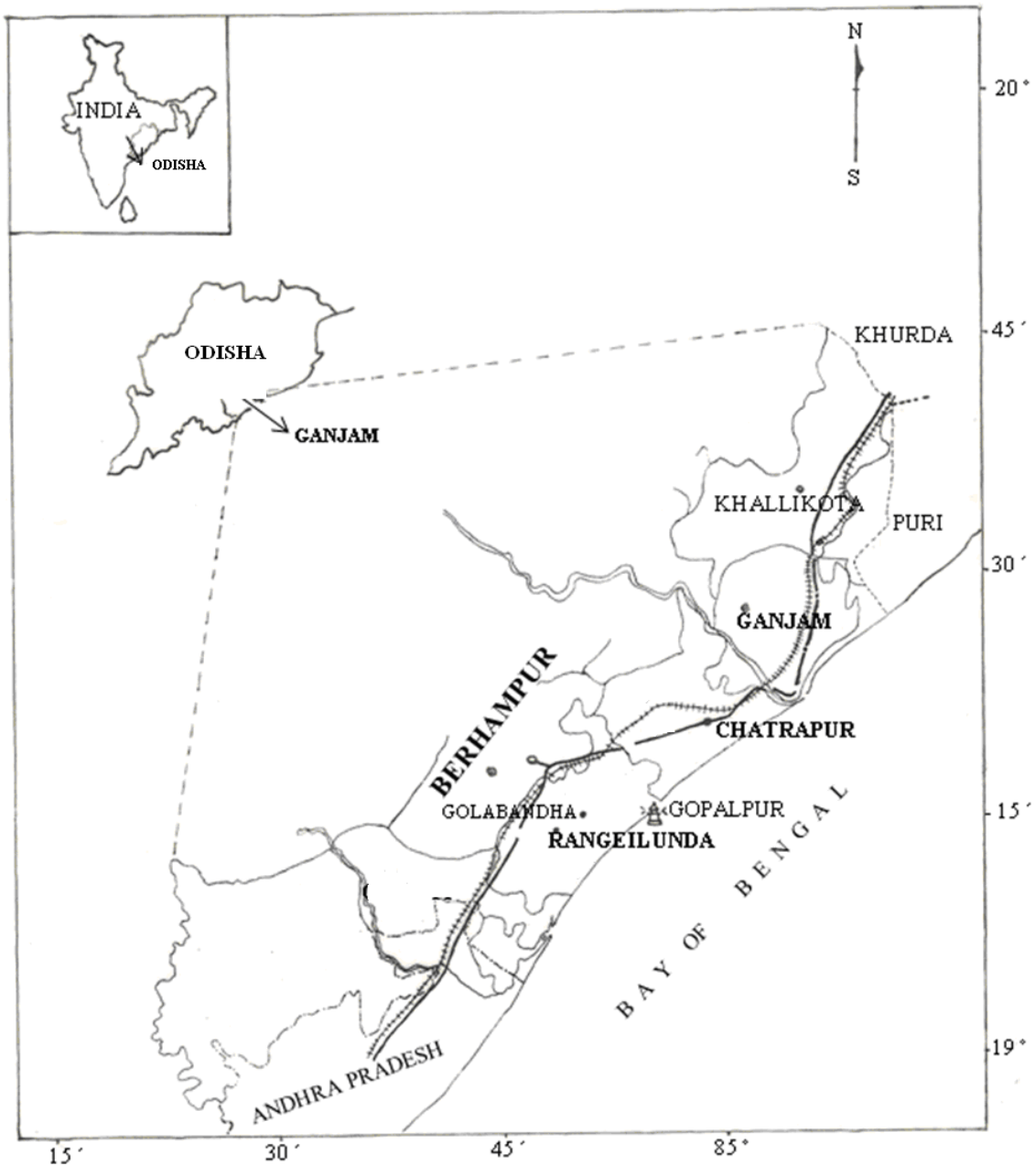

Table 1
Average Annual Rain Fall and Ambient Temperature at Gopalpur, Ganjam, Odisha during 2011-2012

Month	Temperature (0C)		Rainfall (mm)
	Minimum	Maximum	
2011			
July	26.0	31.8	136
Aug	25.7	30.1	315
Sept	25.2	32.0	539
Oct	23.1	30.3	111
Nov	19.6	30.2	-
Dec	15.7	28.1	0.9
2012			
Jan	18.1	27.7	39.6
Feb	20.2	30.3	18
Mar	23.7	30.5	-
Apr	23.7	31.8	47.8
May	27.3	32.8	6
June	-	-	172
Total	1385.3		

Total annual rainfall of the area was 1385.3 mm during 2011-2012 (Table 1). No rainfall was observed in November 2011 and March 2012. The highest rainfall (539 mm) was received in September, 2011, while the minimum rainfall (0.9 mm) was received in December, 2011.

Aim of the Study

The present paper designed to study the ecological study on coconut palm and to study the morphological parameter and biomass of different parts of coconut palm in coastal Ganjam district of Odisha for which less literature is available.

Review of Literature

Coconut is one of the most economically vital crop in tropics, serving as a source of food, drink, fuel, medicine and construction material (Athauda *et al.* 2015; Thomas *et al.* 2007; Medda *et al.* 2008; Ghosh *et al*.2007; Edision *et al.* 2006). Although the coconut palm has significant economic value as a significant crop, there have been a limited number of research papers on its ecology and biomass studies.

Methods

Cocos nucifera L., Sp. Pl. 1188.1753; Haines, Bot. Bihar & Orissa 3:880(922). 1924; Fischer in Gamble Fl. Madras 3:1557(1086). 1931; Saxena & Brahmam, Fl. Orissa 4:2019. 1996. O.: *Nadia.*

The coconut palm belongs to family Arecaceae. It is locally called "nadia" (in Odia); Narikel (Bengal), Nariyal (Hindi); Kbhari chettu, Narikelumu, Tenkaya (Tamil); Coconut (English).

For the present study 25-40 age old coconut plantations were selected in the Ganjam coastal area. The coconut variety under study that is planted in coastal Ganjam is *East coast tall (ECT)*. The method includes both survey and experiment. Survey was carried out in the field with the help of a special questionnaire and the experimental work includes collection of different samples from the field and processing in the laboratory. Different parts of the coconut palm were collected for biomass measurement from different sites. Dry weight of different components of the leaves and ripe coconut were determined by keeping the samples in a hot air oven for a minimum period of 48 hours. The moisture contents of different parts were determined.

Results

Morphology Parameter

For the measurement of coconut leaf lengthwise and width wise measurement is done.

Table 2
Total number of Plants per Acre in Different Sites of Coastal Ganjam district of Odisha

District	Total number of plants per acre		
	Site 1	Site 2	Site 3
Ganjam	107.333	102.857	115.625

Table 2 shows the number of coconut palm in different studied sites of coastal Ganjam district of Odisha.

Table 3
Length of Coconut Leaf (cm) in Different Sites of Ganjam District of Coastal Odisha
Mean±SD

Site 1	Site 2	Site 3		
Length of coconut leaf (cm)				$LSD_{(0.05p)}$
379.14 ±36.09	377.37 ±38.64	381.26 ±42.36	-	38.65

Table 3 depicted the length of coconut leaf where in site 3 has maximum length 381.26 cm and the minimum length was 377.37 cm in site 2 and the least significant difference between sites is 38.65 at 0.05p value.

Table 4
Leaf Length without Mid-Rib in Different Sites Of Ganjam District of Odisha
Mean±SD

Site 1	Site 2	Site 3	$LSD_{(0.05p)}$
Length of coconut leaf (cm)			
319.95 ±7.515	317.94 ±7.366	321.12 ±3.673	6.424

Table 4 shows the leaf length of coconut leaf without mid-rib, site 3 has highest leaf length 321.12

cm and the site 2 has lowest leaf length without mid-rib 317.94 cm and LSD value is 6.424.

Table 5
Width of the Mid-rib (cm)
Mean±SD

	Site 1	Site 2	Site 3	$LSD_{(0.05p)}$
Base	16.86 ±10.75	16.600 ±10.12	18.95 ±13.48	11.39
Middle	4.22 ±3.59	3.911 ±3.337	4.98 ±4.99	3.98
Top	1.033 ±0.50	0.811 ±0.39	1.34 ±1.08	0.96

Table 5 reveals the width of the mid-rib of three different region of the leaf i.e., Base, middle and top region of the leaf.

Table 6
Width of the Leaf (cm) Mean±SD

	Site 1	Site 2	Site 3	$LSD_{(0.05p)}$
Base	184.14 ±19.88	182.35 ±19.71	185.07 ±15.59	17.96
Middle	229.84 ±24.77	227.76 ±25.22	231.08 ±21.91	23.32
Top	172.14 ±208.16	98.30 ±26.87	100.78 ±30.40	118.90

Table 6 reveals the width of the leaf in the studied sites. The width of the leaf ranged between 182.35 cm (site 2) to 185.07 cm (site 3) in base region. In middle region of leaf it varied from 227.76 (site 2) to 231.08 cm (site 3). Top region leaf width is ranged between 98.30 cm to 172.14 cm in site 2 and site 1 respectively.

Biomass

Table 7
Dry Weight of Different Components of A Coconut Leaf at Different Sites of Ganjam coast
Mean±SD

Sites	Dry weight of one leaf (kg)				
	Mid-rib	Leaflet			Grant Total
		Khadika	Rachis	Total	
Site 1(Gopalpur)	0.65 ±0.43	0.19±0.04	0.54±0.20	0.74±0.19	1.40
Site 2 (Batachatrapur)	0.67±0.42	0.18±0.02	0.55±0.14	0.74±0.12	1.42
Site 3 (Golabandha)	0.67±0.47	0.19±0.05	0.48±0.19	0.68±0.22	1.35

Table 7 reveals the average biomass (dry weight) of different components of a coconut leaf in the studied sites. The biomass of the Rachis without midrib ranged between 0.48 kg (site 3) to 0.55 kg (site 2), the biomass of stiff leaflet midribs (*khadika*) varied 0.18 kg (site 2) to 1.19 kg (site 1, 3) respectively. The minimum biomass of leaf midrib was 0.65 kg in site 1, while the highest biomass was 0.67 kg in site 3 and 2. The total biomass of a coconut leaf ranged between 1.35 kg to 1.42 kg in the sites studied.

Table 8
Moisture Content (%) of Different Components of A Coconut Leaf at Different Sites of Ganjam Coast ±SD

Sites	Moisture content (%)		
	Mid-rib	Leaflet	
		Khadika	Rachis
Site 1 (Gopalpur)	70.4±4.7	44.1±15.0	61.0±13.4
Site 2 (Batachatrapur)	68.9±4.2	43.8±9.2	59.6±12.0
Site 3 (Golabandha)	69.8±5.1	43.2±16.5	64.8±12.4

The moisture content (%) of different components of a coconut leaf in the sites is shown in the Table 8. The moisture content of *khadika* (stiff leaves with midrib) ranged from 43.2 % to 44.1 % in site 3 and site 1, respectively. The minimum moisture content of the midrib of the leaf was 68.9 %, while the maximum moisture content was 70.4 % in sites.

Table 9
Dry Weight of Different Components of A Mature Coconut at Different Sites of Ganjam Coast ±SD

Sites	Dry weight (g)					
	Copra	Shell	Coir	Total	Coconut water	Grand Total
Site 1 (Gopalpur)	61.53±9.66	91.49±2.59	806±86	959.02±98.25	125±4	1084.02
Site 2 (Batachatrapur)	42.14±6.67	88.14±4.61	860±114	990.28±125.28	122±8	1112.28
Site 3 (Golabandha)	46.76±3.58	102.94±5.65	700±81	849.7±90.23	131±10	980.7

The average biomasses (dry weight) of different components of a mature coconut in sites studied are depicted in Table 8.

The biomass of copra of one nut ranged between 42.14 g (site 2) to 61.53 g (site 1), whereas the dry weight of the shell varied between 91.49 g (site 1) to 102.94 g (site 3). The observed minimum dry weight of the coir was 700 g and the maximum was 860 g in site 3 and site 2, respectively. The water content of mature coconut ranged between 122 g and 125 g in site 2 and site 3, respectively.

Table 10
Moisture Content (%) of Different Components of A Mature Coconut at Different Sites of Ganjam Coast ±SD

Sites	Moisture content (%)		
	Copra	Shell	Coir
Site 1 (Gopalpur)	51.8±8.3	30.0±0.8	57.8±4.0
Site 2 (Batachatrapur)	66.3±4.5	32.5±3.7	60.3±1.7
Site 3 (Golabandha)	60.2±4.9	31.3±1.2	63.3±3.8

The moisture content (%) of different components of mature coconut in the sites is shown in the Table 10. The moisture content of copra of mature coconut ranged between 51.8% to 66.3 % in all sites, while the moisture content of shell varied between 30.0 % to 32.5 % in site 1 and site 2, respectively. The measured moisture content of coir ranged from 57.8 % to 63.3 % in sites studied.

Discussion & Conclusion

Coconut is a perennial palm offering a multitude of uses for the mankind and therefore is important for many in the Asia and Pacific region. This crop provides food and beverage and numerous other raw materials to coconut based industries. The coconut palm has about 60 years of economic life span and has been recognized as a crop with tremendous potential for alleviating poverty in the third world (Everard et al., 2000). Therefore, conservation of coconut is of primary importance in the world. Most of the coconut plantations in the coastal Ganjam districts belong to private farmers. The plantations are not managed well and except few they are left as such. In the many of the plantations death of plants/ saplings are observed. Coconut has been integral part of the South Indian diets. The results indicate that per capita consumption patterns of coconut oil and coconut have not changed from 1961-2005(Athauda et al. 2015).

The number of leaflets observed Medda *et al*. (2008) that 100-150 cm. This is because the present plantations are older. The length of the leaf is also observed by Medda *et al.* (2008) whose value is 388 cm.

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