RESEARCH ARTICLE

Oil palm cultivation in waste lands with under-ground water potential –a successful pilot study in Odisha, India

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ABSTRACT

Indian oil palm as a small holders' crop under irrigation, is grown successfully in varied soil and climatic conditions successfully. Yield levels ranging from 15 to 40 t fresh fruit bunch (FFB)/ ha / year was recorded depending upon the management conditions in the eleven states. About 2.0 m ha have been identified in 18 states for growing oil palm under supplementary irrigation. Besides, about 64 m ha wastelands are also available for identifying certain areas with the possibilities of tapping water sources exploiting underground water source, river through water harvesting . A Pilot study conducted in two districts of Odisha, showed a positive results which will go a long way in increasing the area under oil palm.

Key words: Odisha, fresh fruit bunch, oil palm, yield

INTRODUCTION

Oil Palm, (*Elaeisguineensis* Jacq.), a perennial oil yielding crop, naturally found in Africa was successfully brought under commercial cultivation in Malaysia and Indonesia and later in many Asia –Pacific countries including India. Indian oil palm is unique which grew under supplementary irrigation with soil pH up to 8.5, and maximum temperature of more than 45^0C during summer. Yield levels ranging from 15 to 40 t / ha/ year was recorded depending upon the management conditions of oil palm growing states in India. Highest FFB yield of 50 t/ ha was also recorded by a small holder in Karnataka. It is being cultivated as small holders' crop under supplementary irrigation in about 0.3 m ha planted in 12 states. India has a potential to grow oil palm almost 2.0 m ha under irrigation in the 18 states identified by expert committee (DOPR 2012; Rethinam 2013, 2016, 2019). Besides these, India is also having large area of waste lands with underground water potential. According to Ministry of Agriculture and JNU Department of Geography 1986 India has 175 m ha of waste lands. Odisha State where the oil palm cultivation is taken up in waste lands gives a new vistas that there is a scope for such area expansion for oil palm. Sometime back oil palm cultivation in waste lands was promoted under Oil Palm Development Project but discontinued since not much head way could be made. So, the Government discontinued oil palm planting in waste land.

MATERIALS AND METHODS

Waste lands in India

The Indian Council of Agricultural Research (ICAR) defined Waste lands as lands which due to neglect or due to degradation are not being utilized to their full potential. These can result from inherent or imposed disabilities or both, such as location, environment, chemical and physical properties, and even suffer from management conditions. According to integrated wasteland development programme, wasteland is a degraded land which can be brought under vegetative cover, with reasonable effort, and which is currently under utilized and land which is deteriorating for lack of appropriate water and soil management on account of natural causes. Waste lands are of different types like cultivable wastelands, and uncultivable wastelands**.** Odisha state has got 18,952.74 sq. km of waste lands of various types (Table 1). The waste lands not cultivated for large number of years with shrubs, small trees, rocky patches, heavy clayey soils belongs to private farmers.

Table 1: Estimated Area under the Wastelands provided by different organization

Source	Area (m.ha.)
Ministry of Agriculture and the JNU, Deptt. Of Geography (1986)	175
National Land Use and Wasteland Development Council (First Meeting 1986)	123
Society for Promotion of Wasteland Development (1982)	145
Ministry of Rural Development & NRSA (2000)	64

OIL PALM IN THE WASTE LANDS OF ODISHA

Odisha state has got 18,952.74sq.km of waste lands of various types. The waste lands not cultivated for long number of years with shrubs, small trees, rocky patches, heavy clayey soils belonging to private farmers have been purchased by private companies were utilized for oil palm cultivation after clearing bushes, levelling partially and exploiting the under-ground water, rivers and nalas are given (Fig. 1).

a) Preparation of land for Planting Oil Palm Seedling

b) Aview of young plantaion c) Oil palm with sunhemp in basin d) Mulching the basin

e) **f)**

View of oil palm in rocky patch


g) Five year old Oil Palm plantation in Badliapara


(h&i) Harvesting FFB at Koska

j) Palm basin covered with plastic mulch


k) Water harvesting sources

Irrigation sources River Pumping Water harvesting structures




I Bore well

PREPARATION OF LAND FOR PLANTING OIL PALM-PILOT STUDY

Land clearing was made by following the norms of forest department leaving the tall trees and clearing the bushes and other small plants. After clearing the land, pits were taken using pot hole digger with 8.26 x 8.26 x 8.26 m spacing to accommodate 180 palms/ ha with oil palm from July 2011 to August, 2014 comprised of Ghana, Deli Dura planting material, imported from ASD Costa Rica. Wherever shallow soils are there, the pit size was increased to 9 m^3 and some times more than were also taken using proclainemachine to have wider pits. The pits were filled with top soil and planting was done at a depth of 20 to 30 cm using 35,583 seedlings in 12 plantation sites. The age of seedlings ranging from 13 to more than 24 months (Table2). After planting, basins were formed around the seedlings and sun hemp (*Crotoleriajuncia*), as green manure crop was added. This helped to prevent weed growth, to maintain microclimate in the root zone and also to protect from heavy wind besides adding bio mass to soil. Since the irrigation source was not ready at the time of planting in most of the plantations, pot watering was given for some months and then drip irrigation was installed for giving irrigation. Though the rainfall extends from June to October, the crop suffered during the months of April and May every year. Regular manuring was given in split doses and after two years of planting, fertigation was given with urea, Di ammonium phosphate and Muriate of potash. Manure dose of 2300 to 2600 g Urea, 1500 g DAP, 3000g MOP, 100g Boron, 500g Mg SO_4/ palm /year applied in split doses (Table 3).

Recently during the year 2017 polythene sheet mulching at the Palm basins and only one time application of annual dose of fertilizer comprising of 500to 1600of Urea, 100 to 800 of DAP, 1100 to 4500 of SOP, 100 to 200 of Boron, 5kg of vermin-compost and 25kg of FYM was applied before laying out polythene mulch and drip laterals were placed below the polythene sheet.The monsoon rainfall starts from June and extend up to September and in remaining months only scanty rainfall is received. The annual rainfall received in the two districts from 2014 to 2018 are given in table 4.Pollinating weevils were introduced at 2.5 years of planting. The flowering started at 18 to 20 months after planting, ablation was done till the age of 2 years and six months and the first harvest was made within 3 years. Regular harvesting was done at monthly intervals.

Table 2: Details of oil palm planting in various sites

SI. No.	Site	Company Name	District	No. of Plants	Planted Area	Source of Water	Month of Planting	1st Harvesting
1	Anlapata	Nayagarh Agriculture Pvt.Ltd.	Nayagarh	2933	40.74	River	June'11 to August'12	May'14
		Angul Oil Palm Ltd	Nayagarh	1526	21.19	River	June'11 to August'12	May'14
2	Koska	GaniaAgro Pvt. Ltd.	Nayagarh	2723	37.82	Canal	March'10 to June '13	Apr'13
		Daspalla Agro Pvt.Ltd.	Nayagarh	1440	20.00	Canal	March'10 to June '13	Apr'13
3	Brundabanpur	Daspalla Oil Palm Pvt.Ltd.	Nayagarh	1545	21.46	WHS & Borewell	July' 2011	May'14
4	Gochhabari	Poibadi Agro Pvt. Ltd.	Nayagarh	900	12.50	WHS	July'2013	Apr-17
		RanpurAgro Pvt. Ltd.	Nayagarh	480	6.67	WHS & Borewell	July'2014	16-Mar
5	Sankulei	KantamalAgro Pvt. Ltd.	Boudh	2160	30.00	Nala , Pond, Borewell	August'12	March'16
6	Thakurmunda	BanapurAgro Pvt. Ltd.	Boudh	1916	26.61	Nala	July'2014	Aug’ 17
7	Bhabapur	SonepurAgro Pvt Ltd	Boudh	2774	38.53	Nala	July'2012	July'15
		Madhusudanpur Agro Pvt. Ltd	Boudh	692	9.61	Nala	July'2012	July'15
8	Birapratapur	SikoAgro Pvt. Ltd.	Boudh	1441	20.01	Borewell	July' 2011	May'14
		CharichakAgro Pvt Ltd	Boudh	1310	18.19	Borewell	July' 2011	May'14
9	Dihikupa	KuskaAgro Pvt. Ltd.	Boudh	4298	59.69	River	June'12 to Augst'13	Aug’ 15
10	Kelakata	BolagarhAgro Pvt. Ltd.	Boudh	1607	22.32	Nala	June'13	Sept'16
11	Badaliapada	PadmapurAgro Pvt.Ltd.	Boudh	1998	27.75	WHS & Borewell	July' 2011	May'14
		Madhapur Agro Pvt. Ltd.	Boudh	1966	27.31	WHS & Borewell	July' 2011	May'14
		BhapurAgro Pvt. Ltd.	Boudh	2594	36.03	WHS & Borewell	July' 2011 to Augst 2014	May'14
12	Dumalapali	BadaliapadaAgroi Pvt. Ltd.	Boudh	1280	17.78	River	Sept'12 to Aust'14	April'16
Total				35583	494.21			

Table 3: Annual dose of fertilizer application after three years.

				Dose of fertilizers applied					Dose of fertilizers appliedin 2016-17				
Site	**PS**	**Place**	**No of plants**	**Urea**	**DAP**	**MOP**	**Boron**	**Magnesium Sulphate**	**Urea**	**DAP**	**MOP**	**Boron**	**Magnesium Sulphate**
Anlapata	1		1311	2600	1500	3000	100	500	2405	1391	2794	100	500
	2		1175	3850	1500	3000	100	500	3760	1498	3010	100	500
	3		1308	3220	1500	3000	100	500	2900	1391	2795	100	500
	4		665	2600	1500	3000	100	500	2405	1284	2795	100	500
				0	0	0							
Koska	1	Second plot low area	661	3850	1820	3000	100	500	3575	1667	2850	100	500
	1	1st plot	280	2600	1500	3000	100	500	2590	1567	3010	100	500
	1	Demo	293	3220	1500	3780	100	500	3265	1498	3670	100	500
	2		1179	2600	1500	3000	100	500	2220	1284	2580	100	500
	3		982	2600	1500	3000	100	500	2590	1498	3010	100	500
	4		768	3850	1500	3780	100	500	2475	963	2430	100	500
Brundabanpur	2		994	2600	1500	3000	100	500	2205	1376	3075	100	400
	1	Plastic Mulching	360	2600	1500	3000	100	500	2600	1500	3000	100	400
	1		191	2600	1820	3780	100	500	2030	1177	2365	100	400
Gochhabri	1		900	2600	1500	3000	100	500	1110	646	1290	0	0
	2		480	2600	1500	3000	100	500	1110	642	1290	0	0
Poibadi				2600	1500	3000	100	500	2405	1365	2795	100	500
Kelakata	1		463	2600	1500	3000	100	500	2405	1391	2795	100	500
	2		557	2600	1500	3000	100	500	2960	1712	3440	100	500
	3		340	2600	1820	3780	100	500	2035	1361	2970	100	500
	4		247	2600	1500	3000	100	500	1295	749	1280	50	250
Dumalapali	1		200	2600	1500	3780	100	500	2590	1498	3555	100	500
	2		810	2600	1500	3780	100	500	2590	1498	3505	100	500
	2	Entry area (A & B)	187	2600	1500	3000	100	500	2590	1498	3505	100	500
	3		83	2600	1500	3000	100	500	2590	1498	3335	100	500
Badaliapada	1		909	2600	1500	3000	100	500	2590	1498	3010	100	500
	2		424	2600	1820	3000	100	500	2590	1774	3010	100	500
	3		665	2600	1500	3000	100	500	2590	1498	3010	100	500
	4		679	2600	1500	3000	100	500	2590	1498	3010	100	500
	5		1104	2600	1500	3000	100	500	2590	1498	3010	100	500
	6		432	2600	1500	3000	100	500	2220	1284	2580	100	500
	7		512	2600	1500	3000	100	500	1233	713	1433	100	500
	8		570	2600	1500	3000	100	500	2590	1498	3010	100	500
	9		809	2600	1820	3000	100	500	2590	1567	3010	100	500
	10		454	2600	1500	3000	100	500	2590	1498	3010	100	500
Sankulei	1		710	2600	1500	3000	100	500	1665	963	1935	100	500
	2		1040	3850	1500	3000	100	500	1850	1070	2150	100	500
	3		410	2600	1500	3000	100	500	1850	1070	2150	100	500
Birapratappur	3		729	2600	1500	3000	100	500	2220	1284	2580	100	500
	4		581	2600	1500	3000	100	500	2220	1284	2580	100	500
	5		310	2600	1500	3780	100	500	2590	1498	3450	100	500
	6		880	2600	1500	3780	100	500	1480	856	2105	100	500
	7		251	2600	1500	3000	100	500	2405	1391	2795	100	500
Bhabapur	1		901	2600	1820	3000	100	500	2220	1514	2365	100	500
	2		808	2600	1500	3000	100	500	2220	1605	1935	100	500
	3		815	2600	1500	3000	100	500	1665	963	1935	100	500
	4		942	2600	1820	3780	100	500	1665	1170	1620	100	500
Dihakupa	1		886	2600	1500	3000	100	500	1480	856	1720	50	250
	2		1194	2600	1500	3000	100	500	1110	642	1290	0	0
	3		801	2600	1500	3000	100	500	1480	856	1720	100	500
	4		600	2600	1500	3000	100	500	1850	1070	1290	100	500
			817	2600	1500	3000	100	500	1295	749	645	100	500
Thakurmunda	1		437	2600	1500	3000	100	500	1850	1070	2290	100	500
	2		895	2600	1500	3000	100	500	2220	1284	2935	50	250
	3		684	2600	1500	3000	100	500	1665	963	1935	50	250
			35583										

Table 4: Annual Rainfall in the selected Districts

Year	Nayagarh	Boudha
2014	1405.9	1706.7
2015	1127.0	1072.5
2016	1148.2	1133.8
2017	1195.0	1154.1
2018	1437.3	1627.9

RESULTS AND DISCUSSION

Initial performance of Oil Palm in Captive plantations in waste lands

Though these plantations were taken with aged seedlings, and some seedling were repeatedly pruned to reduce the seedling growth and planted, pot watering of about 10 liters/plant was given once in 2 or 3 days interval immediately after planting and 100 l/day/palm once in 2 or 3 days to the young planting when the drip was installed, the vegetative growth of the palm was generally good with more number of leaves, flowers and fruit bunches and average bunch weight ranging from 5.0 to 8.0 kg. When water is not adequate more of male flowers were seen.If adequate irrigation water is given to these palms regularly the FFB yield level would easily reach 15 to 18 t/ha/year. The month wise yield pattern of two big plantations is given in Figure 1 and 2. The pattern of yield is very similar in both plantations which is also similar to that of irrigated oil palm in the cultivable land in the state.

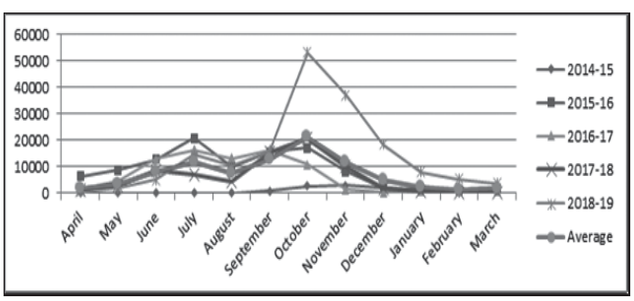

Fig. 1: Month wise yield pattern of Badaliapada plantation (in kg)

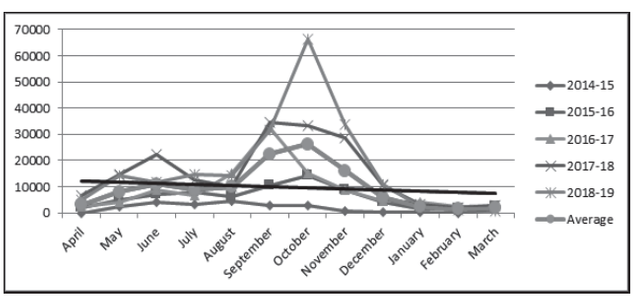

Fig.2: Month wise yield pattern of Anlapata plantation (in kg)

Though 12 plantations were planted in 12 locations, only four major locations *viz* Anlapata, Koska. Badaliapara and Birpratappur were discussed here under representing two soil types The first two were in light textured soils and the other two are black soils. The results obtained on bunch number, bunch weight and yield are presented in table 5, 6, 7 and 8.

In all the locations there is a general increase in bunch numbers, bunch weight and yield over the years. Since the crop had suffereddue to lack of moisture in some years, low FFB yields were recorded. Failure of monsoon and dropping of water table resulted in short supply of water to the palm.

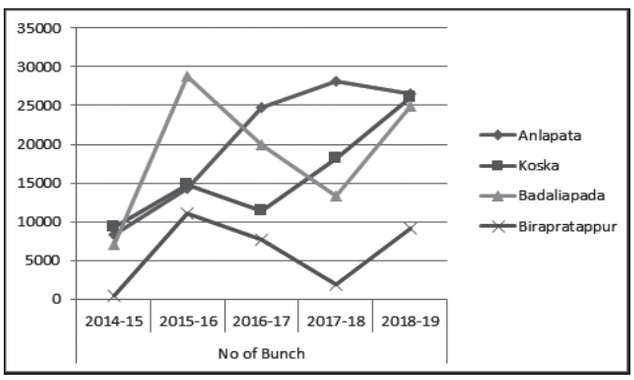

Fig. 3: Number of bunches in four plantations

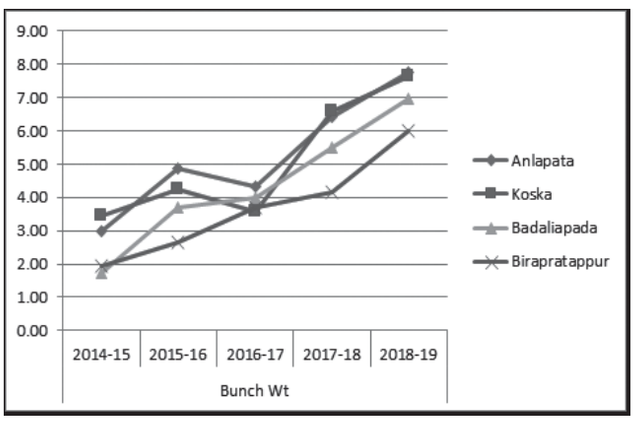

Fig. 4: Bunch Weight in four plantations (in Kg)

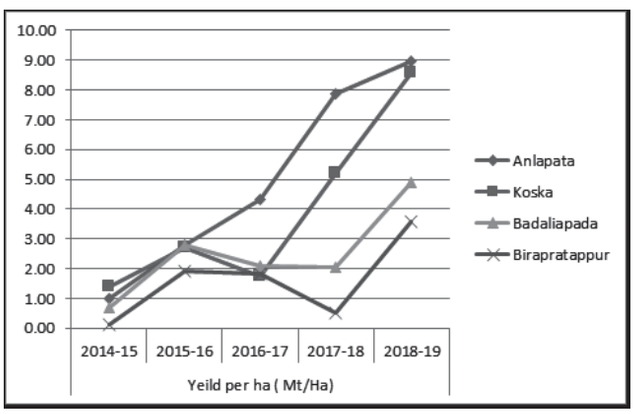

Fig.5: Yield per ha in four Plantations

Table 5: Number of bunches harvested in four plantations over years

Place	2014-15	2015-16	2016-17	2017-18	2018-19
Anlapata	8365	14304	24771	28093	26577
Koska	9260	14707	11411	18202	25990
Badaliapada	6972	28779	19892	13402	24976
Birapratappur	395	11105	7670	1920	9095

Table 6: Bunch Weight (kg) in four plantations over years

Place	2014-15	2015-16	2016-17	2017-18	2018-19
Anlapata	2.97	4.86	4.31	6.44	7.75
Koska	3.45	4.23	3.57	6.60	7.62
Badaliapada	1.72	3.70	4.01	5.50	6.98
Birapratappur	1.95	2.65	3.69	4.14	5.98

Table 7: Yield (mt/ ha) in four plantations over years

Place	2014-15	2015-16	2016-17	2017-18	2018-19
Anlapata	1.00	2.81	4.31	7.86	8.95
Koska	1.38	2.69	1.76	5.19	8.57
Badaliapada	0.68	2.79	2.09	2.07	4.90
Birapratappur	0.11	1.93	1.85	0.52	3.59

Table 8: FFB harvested in four plantations over year

Place	2014-15	2015-16	2016-17	2017-18	2018-19
Anlapata	24815	69548	106709	180811	205879
Koska	31967	62260	40751	120120	198170
Badaliapada	11971	106493	79700	73676	174338
Birapratappur	770	29483	28284	7946	54390

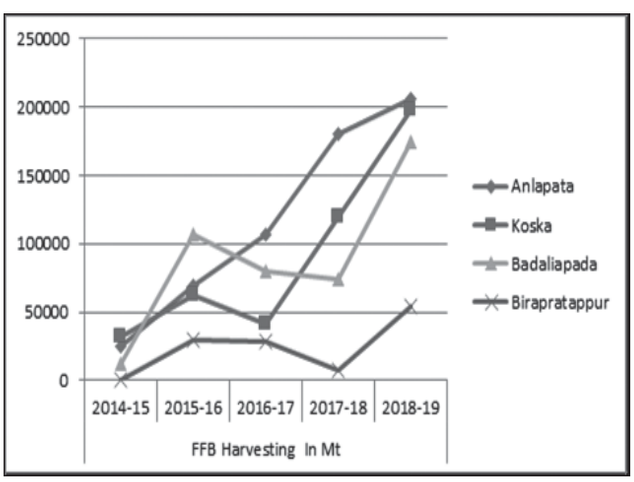

Fig. 6: FFB Harvested in four plantations

CONCLUSION

The present pilot study has clearly indicates that oil palm in wastelands with supplementary irrigation comes to flowering in 18 months after planting and showed increasing trend terms of bunch number, bunch weight, harvested and FFB yield over years.

Oil Palm in wastelands with irrigation by tapping the ground water sources, through open wells and tube wells; digging water harvesting structures to store the rain water, and pumping water from rivers and nalasis possible to get fairly good yields if adequately irrigated. Wherever thereis water deficit, the bunch number,

bunch weight and in turn the FFBharvested and yield reduction were observed . However, the general trend of harvesting from third year recorded increase in number of bunches; bunch weight and FFB yield over the years are quite encouraging.

A systematic pilot study with 1000 to 2000 ha of waste lands with identified assured underground water source in the respective states either allotted to a group of farmers to grow oil palm with the involvement of Processors operating in the respective areas or allotted the land to the processors on long term lease basis to start with and then extend the cultivation to 4.0 to 5.0 m ha of waste lands in the 18 potential states for oil palm, it would be possible to produce 10 to 15 million tons of palm oil and 1.0 to 1.5 m tons of palm kernel oil per year additionally from waste lands and that will go a long way to increase the total palm oil pool which will a long way in increasing the vegetable oil pool in the country.

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