



# Yield estimation of coconut in Tumkur district of Karnataka

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## Abstract

Coconut in India is cultivated mainly in the states of Kerala, Tamil Nadu, Karnataka and Andhra Pradesh which account for more than 90 per cent of area and production of coconut in the country. With about 10 million people dependent on coconut farming and its allied activities, it contributes to more than 83,000 million rupees to the country's GDP and about 6 per cent to the edible oil pool. However, there are no precise estimates of its production and productivity. The official statistics on area and production of coconut is being published with two years lag by the Department of Economic and Statistics and hence an assessment of surplus/deficit production and its repercussion in the coconut market economy could not be made many times. Absence of such statistics at the right time for timely dissemination to stakeholders is considered as an impediment for the development and growth of the industry. Coconut Development Board initiated statistical survey for estimation of production of coconut across major coconut growing states in India by undertaking field surveys and yield estimates based on established phenotypic characters of the buttons/nuts. The estimation was carried out in Tumkur district of Karnataka also which has the highest area under coconut. A total of 406 farms were surveyed in four taluks of the district covering 4060 bearing palms for productivity estimation. The average number of nuts per palm across all age groups for the district as a whole was 98 nuts. The average productivity for Karnataka which was much below to all India average before 2010-11 saw sudden surge post 2011-12. Questions arise as to what are the underlying factors for such sudden spikes. Across many, data capture, estimation and reporting are critical which go on to determine the decision making process on development and growth of the sector. Decisions are formulated on fixation of prices, trade, planning and execution of welfare schemes and policy making. Hence, scientific estimation initiated by Coconut Development Board on production and productivity augurs well for the sector.

*Keywords:* Coconut, productivity differential, Tumkur, yield estimation

## Introduction

Coconut in India is cultivated mainly in the states of Kerala, Tamil Nadu, Karnataka and Andhra Pradesh which account for more than 90 per cent of area and production of coconut in the country (GoI, 2014). Coconut provides food and livelihood security and employment opportunities to a major segment of the rural population in India. It is estimated that the crop contributes to more than ₹ 83,000 million to the country's GDP and about 6 per cent to the edible oil pool. About 10 million people are dependent on coconut farming and its allied activities. The industry also helps to earn foreign exchange to the tune of ₹ 13,000 million per annum by exporting coconut and coconut

products (Approach paper for 12<sup>th</sup> five year plan). However, there are no precise estimates of its production and productivity. The absence of such statistics at the right time and its timely dissemination to farmers, processors, entrepreneurs, policy makers are considered as an impediment for the development and growth of coconut industry. Also, a major hurdle for proper planning and execution of market intervention scheme, designing policies and implementation for agricultural betterment is unavailability of such statistics. The trade in coconut is characterized by significant price fluctuations forcing farmers to dispose off their produce at non-remunerative prices. Sometime these price fluctuations affect the coconut economy

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through externally induced factors such as influx of cheaper vegetable oils and fats threatening livelihood of farmers. To address these issues, there have been several new initiatives and institutional mechanisms which include Information and Communication Technology (ICT) application in trade, market intervention schemes and unified market platforms. Precise reporting of statistics on production, prices, trade and its timely dissemination complement not only the farmers, processors and entrepreneurs but also policy makers designing such new initiatives to foster development and growth of the coconut industry. However, the official statistics on area and production of coconut is being published with two years lag by the Department of Economic and Statistics and hence an assessment of surplus/deficit production and its repercussion in the coconut market economy could not be made many times. In this regard, Coconut Development Board (CDB) initiated statistical survey for estimation of production of coconut across major coconut growing states in India by undertaking field surveys and yield estimates based on established phenotypic characters of the buttons/nuts. The estimation was carried out in state of Karnataka also which has an area of 515,030 hectares under coconut and is ranked second in terms of area in the country (GoI, 2014). Within Karnataka, Tumkur district has the highest area under coconut cultivation (GoK, 2012). Located in the eastern belt in the southern half of the state, the district is 2119 ft above MSL with a geographical area of 10648 km<sup>2</sup> and receives an annual rainfall of 540 mm. The district with 10 taluks has a population of 2.68 million with a literacy rate of 74.3 per cent. Because of diverse agro-climatic conditions, agriculture and horticulture activities are widely practiced. Among horticultural crops cultivated in Tumkur, coconut has the highest area under cultivation. The district is popularly referred to as *Kalpatharu Nadu*, a name associated with coconut. The *taluks* of Gubbi, Tiptur, Thruvekere and Chicknayakanahalli contribute to 80 per cent of the area under coconut cultivation in the district. In this context, the statistical survey funded by CDB was undertaken in Tumkur district by the author for past three years (2013-14 to 2015-16). An attempt is made in this paper to highlight the importance of precise estimation of yield and

production in decision making process by carrying out the statistical survey in Tumkur district of Karnataka during 2015-16.

### Crop productivity estimation

Crop area and production forms the back bone of agricultural systems. There are several methods employed for quantifying production and productivity of agricultural systems for agricultural statistics both at state and national level. Crop area figures are compiled on the basis of complete enumeration, while crop yield is estimated on the basis of sample survey approach. The yield estimates of major crops are obtained through analysis of crop cutting experiments (CCE) conducted under scientifically designed general crop estimation surveys (CES). At present over 95 per cent of the production of foodgrains is estimated on the basis of yield rates obtained from the CCEs (MOSPI, 2008). The Field Operations Division (FOD) of the National Sample Survey Office (NSSO) provides technical guidance to the states and union territories for organizing and conducting CES for estimating yield rates of principal crops. In respect of fruit and vegetable crops in Karnataka, the estimated area and results of crop cutting experiments are conducted under the scheme 'Crop Estimation Survey on Fruit and Vegetable Crops'. For the calculation of production estimates of crops for which no crop cutting experiments are conducted, the yield rates are calculated through oral enquiry of farmers for 21 crops including coconut (GoK, 2013). The other methods of crop yield estimations include; farmers survey where the crop production is estimated through farmers interviews by asking yield for individual plot, field or plot through recall method after harvest. Sometimes crops yields are estimated by summarizing expert opinions of agronomists, extension agents and researchers through visual assessments on crop conditions.

With the rapid change in agricultural production systems the accuracy of the yield estimates becomes challenging to address to the needs of decision makers. In this regard, a more scientific way of estimation of yield of coconut was undertaken based on established phenotypic characters of the buttons/nuts through field surveys initiated by CDB.

## Data and methodology

Tumkur district in the state was purposively selected for the survey as it has the highest area under coconut cultivation. Further, the selection of taluks with in the selected district was based on highest area criterion. Accordingly the taluks of Gubbi, Tiptur, Thruvekere and Chicknayakanahalli which contribute to 80 per cent of the area under coconut cultivation were selected for the survey. From each of the selected taluks, villages for the survey were selected in consultation with taluk agriculture officers on coconut area. Farms/holdings from the selected villages were randomly selected to elicit information on coconut production through a structured questionnaire. A total of 406 holdings/farms from 14 villages of the four taluks were selected for the survey. As per the directions of the officials of the CDB, it was ensured that holding selected had a minimum of 40 bearing palms. Ten palms from each holding were randomly selected to record the number of nuts from three months and above in chronological order. To elicit month wise yield data accurately, trained palm climbers were hired to count the number of nuts per palm and bunch for each of the selected farm apart from eliciting information on holding size, cropping pattern, irrigation status and other related information through a structured questionnaire.

## Holding size and cropping pattern

A total of 406 farms were surveyed for estimation of production and yield of coconut in Tumkur district of Karnataka State during 2015-16. The taluk-wise number of sample farms surveyed is presented in Table 1. The average holding size varied from 1.8 ha in Gubbi taluk to 1.4 ha in Tiptur taluk with 1.6 as the average size of holding for the entire district of Tumkur which indicates that a majority of the farmers dependent on coconut cultivation have smallholdings. A similar situation exists for the country as a whole with 98 per cent of about 5 million coconut holdings are less than 2 ha in size. Almost all the farms selected were more than 15 years old and Tiptur tall was the only coconut variety cultivated across the district. The number of non-bearing palms reported in the study region was relatively low with only 5 to 9 per cent of the total palms in the farm, which is an indication of better management practices followed by the farmers

The average number of palms per farm for the district stands at 185 with highest number recorded in the taluks of Chikkanayakanahalli and Gubbi at 203 and 211 palms per holding, respectively. On an average, the number of palms per ha was the highest at 121 in Chikkanayakanahalli and for the district as a whole the average number was 116 which indicates that farmers have followed a

**Table 1. Sample size and sample villages selected for survey Tumkur district**

Taluk	Number of sample farms	Panchayat/Village
Gubbi	100	Doddaguni, Kondle, Belavattha, Peddanalli Hodaluru
Turuvekere	104	Sampige, Muniyur, Hullekere
Tiptur	127	Gurugadahalli, Tiptur, Kuppal
Chikkanayakanahalli	75	J.C. Pura, Godekere, Dugudehalli

**Table 2. Distribution of samples and average size of holding in the selected taluks for survey**

Taluk	Average number of palm ha <sup>-1</sup>	Average size of holding	Average number palms farm <sup>-1</sup>	Average bearing palms	Average non-bearing palms
Chikkanayakanahalli	121.7	4.1	203	187	15
Gubbi	115.2	4.5	211	198	12
Thruvekere	115.4	3.9	182	171	11
Tiptur	112.9	3.4	155	141	14
Tumkur district	115.9	3.9	185	171	13

**Table 3. Status of irrigation in the selected farms for survey across four taluks in Tumkur district**

Taluk	Sample	Rainfed farms	Irrigated farms	
			Average condition	Good condition
Chikkanayakanahalli	75	6	35	34
Gubbi	100	13	23	64
Thurvekere	104	7	25	72
Tiptur	127	19	39	69
Tumkur district	406	45	122	239

conventional spacing of 9x9 meters in the study region (Table2).

Of the 406 farms surveyed, 361 farms were irrigated and the rest 45 farms were rainfed with an irrigation percentage of 89 (Table 3). This reflects that the district as a whole is endowed with water a critical resource for coconut cultivation. Parts of the study region which include taluks of Gubbi and Thurvekere are well endowed with irrigation source from Hemavathi river and hence the percentage of farms with irrigation was very high. In general, the irrigated farms are well maintained especially in Gubbi and Thurvekere taluks.

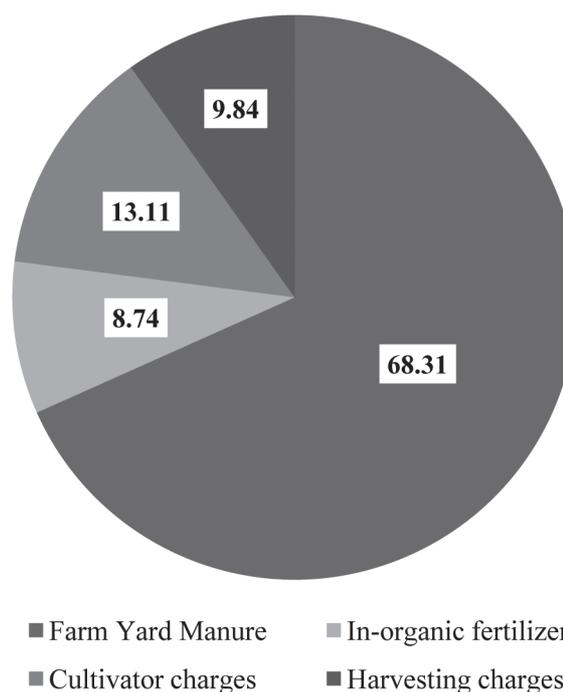
About 73 per cent farms surveyed, practiced mono-cropping of coconut while the rest followed mixed cropping (Table 4). Arecanut and banana were the perennial crops preferred for intercropping with coconut while field bean and fodder crops were the preferred annual crops. One of the reasons attributed for low percentage of adoption of mixed cropping is perennial crops such as arecanut and banana cultivated in the region are highly water intensive crops. Since coconut also responds well to irrigation, water becomes a limiting factor for mixed cropping.

**Table 4. Cropping pattern in the taluks selected for survey in Tumkur district**

Taluk	Farms with mixed cropping	Farms with mono cropping	Total number of farms
Chikkanayakanahalli	20	55	75
Gubbi	16	84	100
Thurvekere	32	72	104
Tiptur	41	86	127
Tumkur district	109	297	406

### Maintenance cost of coconut orchard

On an average, the maintenance cost incurred per ha of the coconut orchard per annum was ₹ 45,201 of which the share of cost of farm yard manure was the highest at 68 per cent followed by cultivator charges at share at 13 per cent (Fig.1). Majority of the farmers in the study region do not apply inorganic fertilizers. With an average density of 116 palms per ha in the region and with an average nut yield of 98 per palm, the total production of nuts per ha stands at 11,368. The average maintenance cost of production per nut works out to ₹ 3.98.

**Fig. 1. Component-wise share of cost of cultivation of coconut in Tumkur, Karnataka**

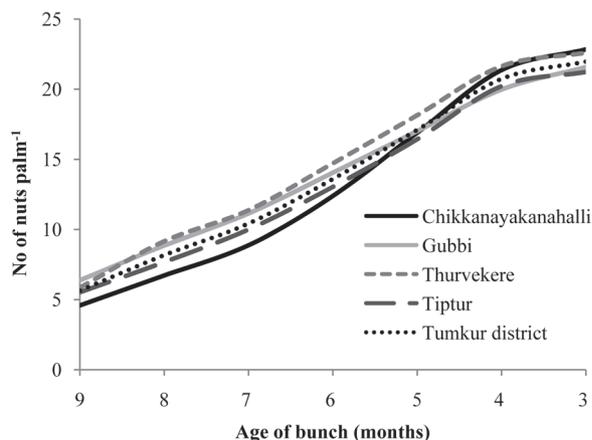


Fig. 2. Taluk-wise average number of nuts per palm for different age bunch

### Productivity differentials

The average number of nuts for different age of the bunch is presented in Fig. 3. The highest number of nuts per bunch at 23 for age group of 3 months was observed in Chikkanayakanahalli while for the district as a whole it was 22 nuts. The average number of nuts per palm across all age groups was the highest in Thurvekere taluk at 103 while for the district as a whole it was 98 nuts per palm (Table 5). However, the average productivity of coconut for the state of Karnataka as a whole is much below to all India average (Fig. 4). In the

Table 5. Taluk-wise yield per palm and per ha in Tumkur district, Karnataka

Taluk	Nuts per palm	Number of nuts ha <sup>-1</sup>	Gross returns ha <sup>-1</sup> (valued @ ₹ 10 nut <sup>-1</sup> )
Chikkanayakanahalli	94	11,394	1,13,941
Gubbi	99	11,403	1,14,025
Thurvekere	103	11,936	1,19,363
Tiptur	94	10,620	1,06,205
Tumkur district	98	11,310	1,13,099

recent years, the average productivity in Karnataka has surpassed the all India average and yield levels from 2011-12 onwards have almost doubled. Gradual expansion in area with improved varieties has been one of the major factors for productivity improvement. However, one has to investigate whether varietal technology post 2010-11 alone is the factor responsible for doubling of productivity. Since coconut being a perennial crop there is a time lag of 5 to 6 years between planting and production to realize and observe yield potentials for varietal improvements. Hence, one possible explanation for such sudden spike could be the way the data has been captured and reported. CDB, post 2010-11, has initiated a scientific and precise statistical survey and estimation of production and productivity. This involves a scientific sampling

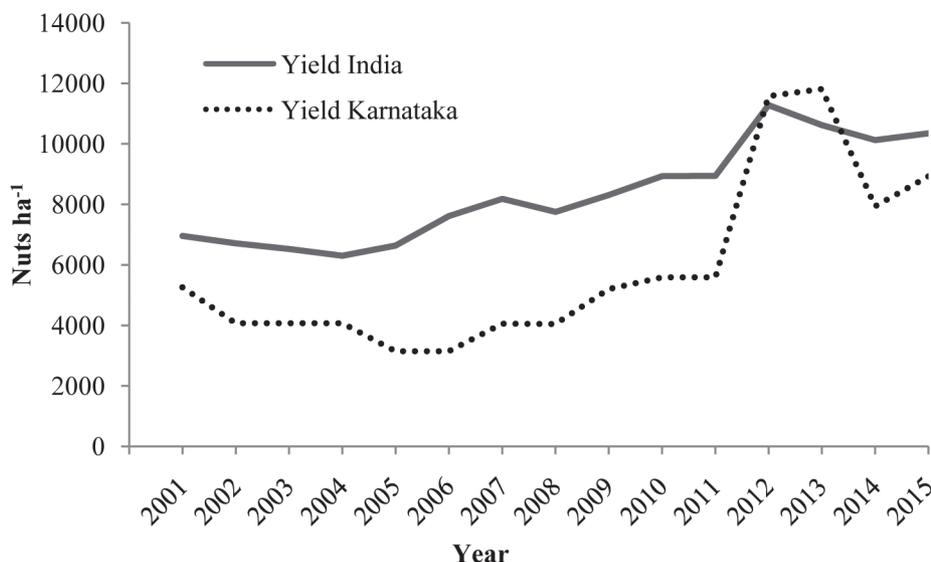


Fig. 3. Productivity differential between India and Karnataka

**Table 6. Net returns (₹) per ha of coconut cultivation in Tumkur district**

Taluk	Gross returns ha <sup>-1</sup> (@ ₹ 10 nut <sup>-1</sup> )	Maintenance cost ha <sup>-1</sup>	Net returns ha <sup>-1</sup> (@ ₹ 10 nut <sup>-1</sup> )	Net returns ha <sup>-1</sup> (@ ₹ 18 nut <sup>-1</sup> )
Chikkanayakanahalli	1,13,941	45,201	68,740	1,59,891
Gubbi	1,14,025	45,201	68,824	1,60,035
Thurvekere	1,19,363	45,201	74,162	1,69,683
Tiptur	1,06,205	45,201	61,004	1,45,977
Tumkur district	1,13,099	45,201	67,898	1,58,379

procedure, selection of a minimum of 40 bearing farms per farm, yield estimates based on established phenotypic characters of the buttons/nuts and counting of nuts by trained palm climbers from each of the selected palms. It is in this regard a precise reporting on official statistics based on scientific estimation procedure by CDB post 2010-11 could be one possible reason for sudden spikes in the data (CDB initiated the statistical survey only during 2013-14 and hence productivity figures are not available for comparison for 2012-13. However, for 2015-16, based on the survey findings, the productivity stands at 11310 nuts ha<sup>-1</sup> for Tumkur district).

Further, both at state and national level, there are inconsistencies in reporting productivity figures which have significant implications on decision making process and implementation of welfare schemes. For instance, the productivity of coconut in Karnataka and Tumkur (the study region) for the year 2012-13 as reported in the publication of Directorate of Economics and Statistics (DES) stands at 7924 nuts ha<sup>-1</sup> and 7890 nuts ha<sup>-1</sup> respectively, whereas, according to the official statistics of CDB, the productivity for 2012-13 stands at 9847 nuts ha<sup>-1</sup> and 9446 nuts ha<sup>-1</sup>, respectively. Under/over estimation of statistics (25% in the present case for Karnataka) by DES and CDB if translated to the entire coconut area in the state have huge ramifications on production, pricing and market instability which impacts both producers and consumers.

### Returns to cultivation from coconut

On an average, the farmers realize ₹ 67,898 ha<sup>-1</sup> from coconut cultivation in Tumkur. The highest return was in the taluk of Thurvekere at 103 nuts per palm in comparison to 98 nuts per palm for the district as a whole. The average price of nut

during 2015 varied from ₹ 10 to 18. Based on a conservative price of ₹ 10 per nut the net returns per hectare at ₹ 67,898 was very modest. However, when the price considered was ₹ 18 nut<sup>-1</sup>, the net returns per ha realized, increased by 2.5 times at ₹ 1,58,379 ha<sup>-1</sup> (Table 6). From the productivity perspective also statistics become critical. As indicated earlier, according to the official statistics of DES if the productivity is 7890 nuts ha<sup>-1</sup>, then the net returns will be 50 per cent of ₹ 67,898 realized at 11,310 nuts ha<sup>-1</sup>. Hence, it is in this respect the stakes for farming are very high as price induced market instability on account of seasonal variations in the production and the resultant impact in the market arrivals, sudden and unexpected price crash. Precise estimation and reporting will go a long way in planning and execution of welfare schemes initiated by the development agencies for coconut. Kumar and Kapoor (2010) highlighted production as a starting point to understand incentivizing coconut production for farmers.

### Productivity differential across rainfed and irrigated farms

An analysis of variations in yield pattern of coconut under irrigated and rainfed conditions showed significant differences. The yield of coconut at 102 nuts per palm under irrigated condition was

**Table 7. Yield of coconut under irrigated and rainfed conditions in Tumkur district**

Taluk	Average number of nuts palm <sup>-1</sup>		
	Irrigated	Rainfed	Overall
Chikkanayakanahalli	97	54	94
Gubbi	104	59	99
Thurvekere	107	50	103
Tiptur	108	55	94
Tumkur district	102	55	98

**Table 8. Net returns (₹) of coconut under irrigated and rainfed conditions in Tumkur district**

Taluk	Irrigated condition			Rainfed condition			Ratio of net returns (irrigation vs rainfed)
	Net returns ha <sup>-1</sup>	Returns palm <sup>-1</sup>	Returns nut <sup>-1</sup>	Net returns ha <sup>-1</sup>	Returns palm <sup>-1</sup>	Returns nut <sup>-1</sup>	
Chikkanayakanahalli	72,977	600	6.2	42,979	353	6.6	1.7
Gubbi	74,618	648	6.2	46,239	401	6.8	1.6
Thurvekere	78,225	678	6.3	35,215	305	6.1	2.2
Tiptur	76,685	679	6.3	40,248	357	6.4	1.9
Tumkur district	72,971	630	6.2	42,000	363	6.5	1.7

double to that under rainfed conditions at 55 nuts per palm (Table 7). However, the overall yield analyzed across all farms (irrigated and rainfed) was marginally low by 4 to 5 nuts per palm in comparison to irrigated farms. The net return per ha under irrigated conditions at ₹ 72,971 is higher by 1.5 times to that under rainfed conditions (Table 8). The highest return was observed in Thurvekere taluk which was better, endowed with irrigation. Efforts should be made by research Institutes working on plantation crops such as ICAR-Central Plantation Crops Research Institute and Agricultural Universities to focus on development and release of varieties which are high yielding under rainfed conditions. Also, water conservation measures and technologies for management of rainfed farms should be the top priority on enhancing yield and incomes of the farmers.

### Returns to storage of coconut

With an average price of ₹ 10 per nut during 2015, farmers realized about ₹ 1,13,099 gross returns per ha in Tumkur district with highest returns observed in Thurvekere taluk at ₹ 1,19,362 per ha. The average cost of producing a nut works out to ₹ 3.94 with a net returns realized at ₹ 6 per nut.

Majority of the farms in the study region stored harvested coconut nuts upto 10 months for converting them to copra. The average price realized for sale of copra by farmers during 2015 was in the range of ₹ 12,000 to 18,000 per 100 kg. The additional return obtained by farmers for storing nut and converting into copra is presented in Table 9. The returns from sale of copra is almost twice to that of selling nuts directly. Copra is in high demand for direct consumption, confectionaries and oil making. It's highly beneficial for farmers to store nuts and convert to copra since the opportunity cost of storage is very high. The additional return from sale of copra instead of sale of nuts varies from ₹ 84,872 to 95,393 per ha across taluks of Tumkur district. On an average for the district as a whole, the additional returns is ₹ 90,379 per ha. The additional returns is an indicator of scope for value addition. However, a detailed study on coconut value chain is not available for Karnataka which is a constraint in decision support for interventions by development agencies such as CDB. Kumar and Kapoor (2010) highlighted the importance of conducting such studies in decision making process.

**Table 9. Net returns to storage of nuts for copra making in Tumkur district**

Taluk	Number of nuts ha <sup>-1</sup>	Nuts converted to copra (qtl ha <sup>-1</sup> )	Value of copra @ 12,000 qtl <sup>-1</sup>	Returns realized ha <sup>-1</sup> if only nuts are sold @ 10 nut <sup>-1</sup>	Additional returns for storage
Chikkanayakanahalli	11,394	17.1	2,04,991	1,13,941	91,050
Gubbi	11,402	17.1	2,05,125	1,14,015	91,110
Thurvekere	11,938	17.9	2,14,768	1,19,375	95,393
Tiptur	10,621	15.9	1,91,082	1,06,210	84,872
Tumkur district	11,310	17.0	2,03,481	1,13,101	90,379

Note: about 6.7 nuts are required to produce a kilogram of copra

## Conclusions

The findings from the study indicate how critical are factors of decision making process such as reporting of statistics which go on to assess the surplus/deficit production and there by their repercussion on coconut market economy. For instance, the average productivity of coconut for the state of Karnataka as a whole which was much below the all India average before 2010-11 saw sudden surge post 2011-12 onwards. Questions arise as to what are the underlying factors for such sudden spikes. Across many, data capture, estimation and reporting are also critical which go on to determine the decision making process on development and growth of the sector. India being the third largest producer of coconut in the World, inadequate reporting and decision making will have adverse implications for the sector. Decisions are formulated with respect fixation of prices, trade, planning and execution of welfare schemes and policy making. Also a more precise estimation procedure by counting month-wise nuts per palm with the help of palm climbers gives the exact production and yield scenario. Hence, a well thought of scientific estimation of production and productivity of coconut initiated by CDB across all the major coconut producing states in India from past few years is a right direction which augers well for all the stakeholders of the coconut

economy more importantly for the welfare of the farmers.

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