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AGE-COMPOSITION OF MATURE AREA UNDER NATURAL RUBBER IN INDIA: A COMPARATIVE ANALYSIS

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The paper revisits a study undertaken by the authors in 2008 on the trends in age-composition of mature area under natural rubber cultivation in India and reviews projected status for the period from 2008-09 to 2014-15. The projections of the earlier study showed that the share of area under the yield-declining phase would rise to touch 53.3 per cent by 2011-12 before falling to 46.0 per cent by 2014-15. The earlier study had also highlighted inconsistencies in the official data and recommended a national census of rubber area for fixing the same. However, the earlier study failed to capture the postponement of the uprooting of rubber trees beyond 22 years of tapping age and the resultant emergence of a senile group of trees having more than 22 years of tapping age. Due to retention of aged trees, the gap between the projected figures of mature area and the corresponding official figures sharply widened from 2.2 per cent in 2008-09 to 25.3 per cent in 2014-15. The area occupied by trees having more than 22 years of tapping age steadily grew by 144.7 per cent during the period from 2008-09 to 2014-15. In absolute terms, the area under this age-group increased from 10,255 hectare to 99,313 hectare with important policy implications. The results of the study reconfirmed the need for a national census of rubber area, as proposed in the earlier study.

Keywords: Age-composition, Average yield, Census, New-planting, Replanting, Tapping age

INTRODUCTION

The over-riding influence of age-composition on the yield and production of perennial crops is widely recognised from the academic and policy perspectives (Wickens and Greenfield, 1973; Nerlove, 1979; George, 1984; French and Gorden, 1985; Akiyama and Trivedi, 1987; George *et al.*, 1988; Narayana, 1994; Jacob and George, 2008). A pioneering study on the influence of changing age-composition of mature area under natural rubber (NR) cultivation in India estimated the annual average yield and production for the period from 2001-02 to 2007-08 based on the historical data on planting in the country (Jacob and George, 2008).The study also projected the annual average yield and production for the period 2008-09 to 2014-15. The estimates of the study for the period 2001-02 to 2007-08 were significantly lower than the official estimates on the annual average yield and production of the crop. Despite the reservations in accepting and revising the published official data on the annual average yield and production,

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growing apprehensions on the supply of NR in the domestic market led to the appointment of a Technical Sub-Committee (TSC) as part of the Expert Committee for the Formulation of National Rubber Policy (ECFNRP), constituted by the Ministry of Commerce and Industry on 16 June 2014. The conclusions of the TSC revealed that the officially reported figures of NR production are over-estimated for all the five years from 2009-10 to 2013-14 (Government of India, 2015). The extent of variation in production between the official data and the recommended data by the TSC ranged from 6.0 per cent in 2009-10 to 18.6 per cent in 2013-14. However, recommended revisions of the data by the TSC were higher than the projections on NR production by the earlier study for all the five years. In sum, the critical issue of arriving at a consensual estimate on domestic NR production based on a census as suggested in the earlier study remains unresolved. Perhaps, the most serious consequence of the emerging scenario is the virtual absence of a reliable database on the age-composition of area under NR cultivation in the country. The issue assumes critical importance in the backdrop of a changing composition of senile area which is neither captured by the official data nor by the methodology employed in the earlier study. Therefore, the focus of the study was an analysis of the trends in the age-composition of mature area under NR in the country during the seven year period from 2008-09 to 2014-15 as the terminal year of the earlier study was 2007-08 (*ibid*). The specific objectives of the study were to compare the total mature area projected by the earlier study with the official data for 2008-09 to 2014-15,to analyse the trends in age-composition of the mature area during the period from 2008-09 to 2014-15 and to highlight the policy implications.

MATERIALS AND METHODS

Age-composition of rubber trees in a year is primarily determined by historical trends in planting and farmers' decisions for postponement or advancement of uprooting in relation to rubber prices or other reasons and discarding of trees. It has been empirically established in the earlier study that rubber trees are largely uprooted at the 29th year of planting. Age-composition of mature area for 2008-09 to 2014-15 was estimated based on the assumptions that *Hevea* attains maturity in the seventh year since planting (*i.e.*, the seventh year of planting is referred to as the 'first year of tapping'), economic yielding phase of *Hevea* spans for 22 years from the seventh year to 28th year since planting, in the 29th year since planting, trees are uprooted and replanted and there is no discarding of trees.

Based on the above, the mature area during the year 't' (say, MA_t) can be segregated in to different age-groups of trees, as shown below:

MA_t = Area under trees in 7th planting year + Area under trees in 8th planting year + Area under trees in 9th planting year +.....+ Area under trees in 28th planting year.

The area under trees in the seventh year since planting is the area new-planted or replanted seven years ago and this may be denoted as $(NP+RP)_{t-7}$.

Therefore, the above statement may be put in the following form:

$MA_t = (NP+RP)_{t-7} + (NP+RP)_{t-8} + (NP+RP)_{t-9} + \rightarrow + (NP+RP)_{t-28}$ (Equation A)

In Equation A, the left-hand side is MA_t (*i.e.*, mature area) for which official figures are available for the years up to 2014-15. Separate terms on the right-hand side are the annual planting data for which official figures are available for the years up to 2015-16.

For any particular year 't', the separate terms of the right-hand side gives the segregation of the mature area into different ages of trees or the age-composition which is also called the vintage structure of the mature area for the year 't'.

If the above-mentioned set of four assumptions strictly holds, the mature area for any year should strictly satisfy equation A. For instance, the mature area for 2014 should be the sum of the area planted (includes both new-planted area and replanted area) during the 22 years from 1986 (*i.e.*, 28 years ago) to 2007 (*i.e.*, 7 years ago).

i.e., $MA_{2014} = (NP+RP)_{2007} + (NP+RP)_{2006} + (NP+RP)_{2005} + ...+ (NP+RP)_{1986}$

But, in reality, mature area is not expected to satisfy the above equation because growers tend to postpone or advance uprooting of aged trees. Possible discarding of trees could also be a cause for deviation from the expected pattern. Therefore, in reality, MA_t could be either less than or greater than $(NP+RP)_{t-7} + (NP+RP)_{t-8} + (NP+RP)_{t-9} + ...+ (NP+RP)_{t-28}$.

If the official figure of MA_t is less than $(NP+RP)_{t-7} + (NP+RP)_{t-8} + (NP+RP)_{t-9} + ...+ (NP+RP)_{t-28}$, it means that trees have been uprooted earlier than 29th year of planting. On the other hand, official figure of MA_t going greater than $(NP+RP)_{t-7} + (NP+RP)_{t-8} + (NP+RP)_{t-9} + ...+ (NP+RP)_{t-28}$ reveals the presence of senile trees belonging to vintages older than 29 years. In this case, the difference between MA_t and $(NP+RP)_{t-7} + (NP+RP)_{t-8} + (NP+RP)_{t-9} + ...+ (NP+RP)_{t-28}$ provides an estimate for the extent of senile trees existed during the year 't'.

RESULTS AND DISCUSSION

The earlier study projected a contraction in mature area during the period from 2008-09 to 2012-13 followed by a marginal expansion in 2013-14 and 2014-15. However, the officially reported data for the same period revealed a steady growth in the mature area. Table 1 shows the differences between the mature area projected in the earlier study and the corresponding official data for the period from 2008-09 to 2014-15.

Table 1 clearly shows the widening gap between the projections of earlier study and official data in absolute and relative terms. In relative terms, the gap sharply widened from 2.2 per cent in 2008-09 to 25.3 per cent in 2014-15. The observed differences deserve further explanation. As mentioned earlier, projections of mature area in the earlier study were based on the result that trees

Table 1. **The projections and official data of mature area (2008-09 to 2014-15)**

Year	Projected mature area (ha)	Official data of mature area (ha)	Excess over projections (ha)	Excess over projections (%)
2008-09	4,52,945	4,63,130	10,185	2.2
2009-10	4,41,267	4,68,480	27,213	6.2
2010-11	4,33,395	4,77,230	43,835	10.1
2011-12	4,26,290	4,90,970	64,680	15.2
2012-13	4,24,125	5,04,040	79,915	18.8
2013-14	4,24,200	5,18,100	93,900	22.1
2014-15	4,26,100	5,34,000	1,07,900	25.3

Table 2.**Tapping age composition of mature area* (ha)**

Year	Tapping age-groups and mature area				Total
	1-3 years	4-13 years	14-22 years	Above 22 years	mature area
2008-09	37,030(8.0)	1,86,977(40.4)	2,28,868(49.4)	10,255(2.2)	4,63,130(100.0)
2009-10	39,010(8.3)	1,71,248(36.6)	2,31,113(49.3)	27,109(5.8)	4,68,480(100.0)
2010-11	39,920(8.4)	1,62,371(34.0)	2,31,122(48.4)	43,817(9.2)	4,77,230(100.0)
2011-12	47,240(9.6)	1,53,730(31.3)	2,27,226(46.3)	62,774(12.8)	4,90,970(100.0)
2012-13	58,280(11.6)	1,48,810(29.5)	2,20,980(43.8)	75,970(15.1)	5,04,040(100.0)
2013-14	73,830(14.2)	1,47,940(28.6)	2,08,598(40.3)	87,732(16.9)	5,18,100(100.0)
2014-15	85,500(16.0)	1,53,070(28.7)	1,96,117(36.7)	99,313(18.6)	5,34,000(100.0)
CARG (%)	21.8	- 3.0	-2.4	144.7	2.6

*Official data on mature area, CARG: Compounded annual rate of growth. Figures given in the parentheses are percentage shares.

would be uprooted for replanting on expiry of 22 years of tapping age. For instance, the total area of 167,300 ha planted during 1979-1986 was expected to be uprooted for replanting during 2008-2015. However, the total area replanted during 2008-2015 was only 83,000 ha as per the official data. More precisely, senile trees in 50.4 per cent of the area to be replanted have been retained beyond 22 years of tapping age. In fact, the area under trees beyond 22 years of tapping age has been steadily increasing from 10,255 ha in 2008-09 to 99,313 ha in 2014-15 (Table 2).

As is reported (Joseph *et al.*, 1999; Chandy and Sreelakshmi,2008), under normal conditions, life cycle yield profile of NR can be broadly divided into three phases, *viz.* yield increasing phase (1-3 years), yield stabilising phase (4-13 years) and yield declining phase (14-22 years). Table 2 is illustrative of not only an unprecedented emergence of a new age group in the yielding phase (Above 22 years) but also recorded the highest growth rate in sharp contrast to the negative growth rate observed in the case of area under the most productive age group of 4-13 years. Similarly, the relative share of this age group has recorded a steady growth from 2.2 per cent in 2008-09 to 18.6 per cent in 2014-15. Conversely, the share of yield stabilising phase (4-13 years) declined from 40.4 to 28.7 per cent during the same period. Despite a positive growth rate observed in the yield increasing phase (1-3 years), the trends in the senile group (above 22 years) call for detailed field level investigations and appropriate policy interventions. In this connection, it is important to understand the differences in the age-composition of mature area based on the projections of earlier study and the official data as given in Table 3.

According to the projections of the earlier study, the share of area under the tapping age group "14 and above" would go up from 50.5 per cent in 2008-09 to 53.3 per cent in 2011-12 before gradually declining to 46.0 per cent in 2014-15. But, the estimates based on official data revealed a worsening age-composition characterised by an increase in the share of area under the tapping age group "14 and above" from 51.6 per cent in 2008-09 to 59.1 per cent during 2011-12. Though subsequently it marginally

Table 3. **Age-composition of mature area based on projections and official data (%)**

Year		Tapping age (years)			Total
		1 to 3	4 to 13	14 and above	
2008-09	Projected	8.2	41.3	50.5	100
	Official	8.0	40.4	51.6	100
2009-10	Projected	8.8	38.8	52.4	100
	Official	8.3	36.6	55.1	100
2010-11	Projected	9.2	37.5	53.3	100
	Official	8.4	34.0	57.6	100
2011-12	Projected	10.6	36.1	53.3	100
	Official	9.6	31.3	59.1	100
2012-13	Projected	12.8	35.1	52.1	100
	Official	11.6	29.5	58.8	100
2013-14	Projected	15.9	34.9	49.2	100
	Official	14.3	28.6	57.2	100
2014-15	Projected	18.5	35.5	46.0	100
	Official	16.0	28.7	55.3	100

declined to 55.3 per cent during 2014-15, the emerging trends have serious policy implications in the context of challenges on the sustainability of NR cultivation in the country.

Apparently, the growers tend to retain aged trees by postponing replanting during upward swings in the market. Logically, postponement or a staggered replanting during high prices enable them to offset the loss in income arising from the low yield obtained from aged trees (Jacob, 1994). On the other hand, high volatility in prices detracts growers from investing in rubber cultivation and the resultant postponement of replanting. The period from 2008-09 to 2014-15 witnessed scaling of NR prices to unprecedented peaks followed by sharp downslides. The observed severe short-fall in replanting during 2008-15 is largely ascribed to farmers' response to the volatility in prices. On the other side of the spectrum, fall in the prices since 2012 is reinforcing growers' perceptions regarding the postponement of replanting due to lack of farming alternatives and compatible policy interventions. In practice, the major contributory factor for the erosion of growers' confidence is the higher instabilities in farm income during the post-reforms phase (Chandy *et al.*, 2010).

CONCLUSION

The objectives and contents of the present study was different from the earlier study for the policy implications in spite of the logical continuity and the methodology employed. The earlier study highlighted the inherent contradictions of the official database on NR production sector by illustrating the incompatibilities among data on historical planting, age-composition, yield and production during 2001-02 to 2007-08. Based on the methodology employed, projections also were made for the period between 2008-09 and 2014-15.

The focus of the present study was confined to the changing dimensions of the age-composition leading to an unprecedented emergence of a new age group and its varied dimensions. To a large extent, the results of the study reconfirmed the policy proposition mooted in the earlier study to conduct a national census on the age-composition of area under the crop. The postponement of the census is loaded with more serious consequences than postponement of replanting.

REFERENCES

Akiyama, T. and Trivedi, P.K. (1987). Vintage production approach to perennial crop supply: An application to tea in major producing countries.*Journal of Econometrics*, **36**(1/2): 133-161.

Chandy, B., George, K.T. and Raj, S. (2010). Trends in farm Income and wages in the era of market uncertainty: An exploratory analysis of natural rubber sector in Kerala. NRPPD Discussion Paper No.5, Centre for Development Studies, Thiruvananthapuram, 22p.

Chandy, B. and Sreelakshmi, K. (2008). Commercial yield performance of *Hevea* clones in the estate sector in India: A comparative analysis. Rubber Research Institute of India, Kottayam 66009, Kerala, India, p.

French, B.C., Gorden, A.K. and Dwight, D.M. (1985). Planting and removal relationships for perennial crops: An application to cling peaches.*American Journal of Agricultural Economics*, **67**(2): 214-223.

George, K.T. (1984). Historical roots of crisis in the South Indian tea industry. *Social Scientist*, **12**(4): 34-50.

George, K.T., Joseph, T. and Joseph, T. (1988). Evaluation of the yield performance of selected rubber planting materials in the context of the planting policy.*Indian Journal of Natural Rubber Research*, **1**(2): 66-78.

Government of India (2015). *Annual Report 2014-15*. The Rubber Board, Kottayam, Department of Commerce, Ministry of Commerce & Industry, p.82.

Jacob, J. (1994).*Staggered replanting and income stabilization: A case study of small rubber holdings in Kerala*. M.Phil. dissertation submitted to Jawaharlal Nehru University, New Delhi.

Jacob, J. and George, K.T. (2008). Ageing of mature area and declining yield profile of natural rubber in India.*Natural Rubber Research*, **21**(1&2): 109-118.

Narayana, D. (1994). Perennial crop production cycle models: Influence of high yielding varieties and prices.*Indian Journal of Natural Rubber Research*, **7**(1): 25-37.

Nerlove, M. (1979). The dynamics of supply: Retrospect and prospect. *American Journal of Agricultural Economics*, **5**: 874-888.

Wickens, M.R. and Greenfield, J.N. (1973). The econometrics of agricultural supply: An application to the world coffee market.*Review of Economics and Statistics*, **55**: 433-440.