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Full Length Research Paper

Quantitative analysis of R and D output on plantation crops in India

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The study examines India's performance on Plantation Crops literature published during 1998 - 2007. The study was undertaken using Horticultural Science Database. The plantation crops are high value commercial crops of greater economic importance and play a vital role in our Indian economy. India enjoys the pride of leading in the production of plantation crops throughout the world. Hence, the R and D activity is assumed to be very high on this subject. The major plantation crops are coconut, arecanut, rubber, tea, coffee, oil palm, cashew and cocoa. Amongst these categories, quantum of publications on 'coconut' is found to be the largest followed by tea in India. This paper investigates the most prolific authors, primary institutions and key journals in major plantation crops are identified and critically examined for its features.

Key words: Plantation crops, quantitative analysis, scientometics, R and D output.

INTRODUCTION

Growth implies "a change of state" or "an increase in size". In Science, it may imply an increase in scientific output, particularly, increase in scientific literature, increase in the size of scientific community or increase in the number of research institutions. A systematic study of these aspects of scientific growth facilitates qualitative and quantitative understanding of science and various scientific phenomena. Growth profiles of individuals, institutions and countries, by way of correlation coefficients between their input variables (manpower and budget) and output variables (number of papers published, processes developed and patents accepted), are important indicators of scientific progress. Information is an important resource for socio-economic and also for Science and Technology (S and T) development.

Often, it is necessary for us to develop or identify certain indicators to measure information for several purposes. According to Vinkler (1996), the simplest indicator of scientific production of any individual, institute or country is its research output in the form of papers, publications, patents etc. If this is related to the number of scientists involved, it gives us a meaningful framework for evaluation. It is very hard to define plantation crops. Opinion varies in exactly classifying these crops. However, generally accepting, plantation crops are artificial man-made stand of woody perennial crops which are grown on large contiguous area, require large and intensive management input and care, possess industrial attributes, create lots of employment generation opportunities. Plantation crops though occupy only a smaller area of 7.33 million ha in the country, play a very vital role in earning considerable foreign exchange and elevating the socio economic status of millions who directly or indirectly depend on these groups of crops, in the cultivation, processing of primary products, value added products, marketing, exporting etc. Many of these healths drink food products, food ingredients, medicines as well as nutrition. Perennial plantation crops also provide materials for shelter, furnitures, decorative like paneling, floor tiles and many aesthetic products and utensils which are biodegradable and eco-friendly.

Analysis of publications of the Central Plantation Crop Research Institute, India was made to give an indication of the performance and function of the institute. Publication lists from the annual reports of the institute were analysed to determine those journals in which these contributions were published. The contents of the publications were divided according to crop and subject disciplines. Results showed that contributions have appeared mostly in 'crop journals' rather than subject

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Table 1. Quantum of world output on plantation crops (1998 - 2007).

Plantation crops	*World contribution*	*Percentage (%)*	*Indian contribution*	*Percentage (%)*
Coconut	2117	16.81	932	28.38
Arecanut	327	2.60	324	9.87
Cashew nut	558	4.43	267	8.13
Tea	3101	24.63	657	20.02
coffee	3202	25.43	526	16.03
Rubber	1113	8.84	297	9.05
Oil Palm	944	7.50	117	3.56
Cocoa	1228	9.75	163	4.96
Total	12590	100.00	3283	100

journals. Most articles and papers have been published on coconut and areca nut amongst the crops and crop protection amongst the subjects (Joshi, 1984).

Arunachalam (2000) has presented an analysis of the contributions of Indian researchers to Life Sciences research as indexed in Biological Abstracts for the period 1992 - 1994. This study aimed to map Life Sciences research in India as reflected by the journal literature, using standard techniques of Scientometrics. It is a macroscopic study at the institutional level and does not analyse the data at the level of individual researchers. The report covered the volume of work published in India, journals often used, their standing (as reflected by their impact factors) and country of publication, subfields in which Indian researchers were active, and the Indian institutions active in publishing their work The methodology adopted for this study was that all papers having a first author address in India were downloaded from BIOSIS Biological Abstracts 1992 - 1994 (CD-ROM, Silver Platter) as addresses of only first authors were given in the database. The years indicate the disc years and not the years of publication of the individual papers. Names of institutions of the authors were standardized. The impact factor values were taken from Journal Citation Reports (JCR) 1992 and 1994, and subfield classifications for journals were taken mostly form SCI guide and for some, from Ulrich's International Periodicals Directory. The data downloaded and grouped were converted into a database and analysed using FoxPro.

Senthilkumaran and Amudhavalli (2004) have investigated the publication profile of spices research in India using HORT-CD. They have identified the major spices, most prolific authors, primary institutions and key journals in Indian Spices research and have critically examined its features

Objective

This study attempts to:

1. Quantify the literary output on plantation crops from 1998 - 2007 at global level.
2. Quantify the Indian literary output on Plantation Crops over a decade.
3. Analyse the R and D priorities on plantation crops in India.
4. Identify the prime Institution and prolific authors engaged in literary output on plantation crops.

MATERIALS AND METHODS

The major plantation crops are coconut, areca nut, rubber, tea, coffee, oil palm, cashew and cocoa. Horticultural Science Database published by the Centre for Agriculture and Biosciences International (CABI), London, UK, It is a unique and valuable database. It provides easy access to the world's horticultural literature from 1973 to present. With informative abstracts covering subjects such as temperate, tree fruits and nuts, small fruits, viticulture, minor industrial crops and tropical fruit, plantation crops and much more. Hence, Horticultural Science Database was chosen for this study. Horticultural Science Database was searched using the name of each plantation crops as the key word in all the fields of each record except Abstracts (AB), Update Code (UD) and Accession Number (AN) fields. Records matching with the keywords were downloaded and were referred to as plantation crops.txt. This file was further subdivided year-wise under each plantation. Using FoxPro, Version 2.5, a working database was created with the required fields only. Since the purpose of the study was to ascertain Indian productive profile, the working database was further searched by the name of each of the plantation crops.

RESULTS

Global level

A search to quantify the world's literature on plantation crops led to identifying the contribution of literary output on the subject. The following table list the literary production on plantation crops at the global and regional levels (India). Table 1 indicates that amongst the plantation crops, coffee rank is high followed by tea, coconut, cocoa, rubber, oil palm, cashew nut and areca nut. The total literary output on plantation crops is 12,590 records.

This data indicates that the total world's literary output on plantation crops is 12, 590 records. Figure 1 indicates that amongst the plantation crops, coffee ranks high with

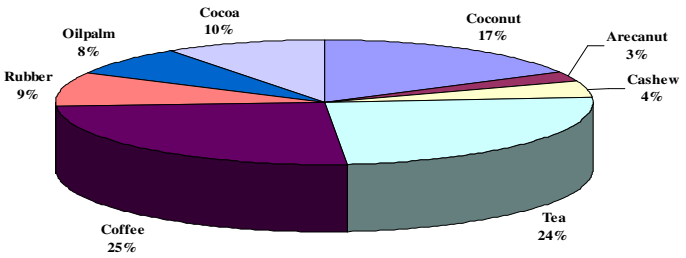

Figure 1. World contribution on plantation crops.

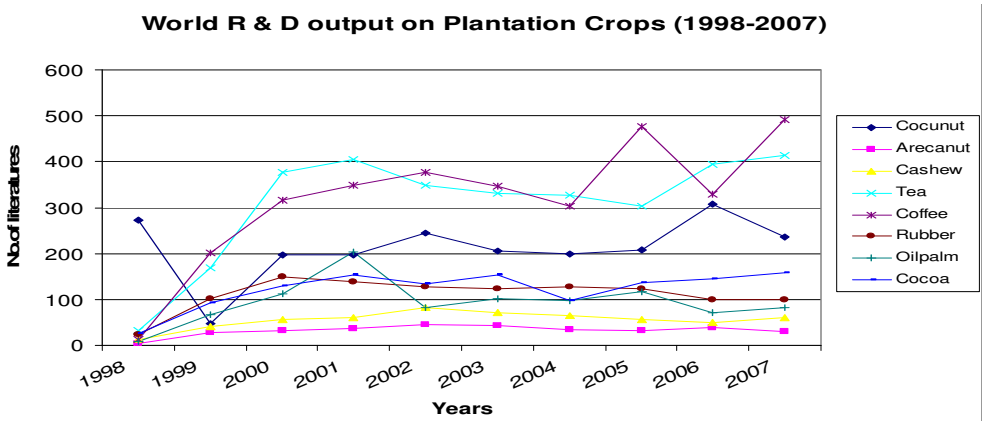

Figure 2. Year vs. plantation crops for 1998 - 2007.

3202 records (25%) followed by tea 3101 (24%), coconut 2117 (17%), cocoa 1228 (10%), rubber 1113 (9%), oil palm 944 (8%), cashew nut 558 (4 %), areca nut 327 (3%).

Chronological analysis of r and d output on plantation crops

An attempt has been made to assess the world quantum of records chronologically to identify the focus of R and D status on plantation crops research. The quantum of publications on 'coffee' is found to be the largest (3202 records) followed by tea (3101 records) at global level during the block periods of the study 1998 - 2007.

Figure 2 depicts a steady increase of publication pattern in plantation crops, from 1998 to 2007. However, the crop coconut showed a sudden decline in 1999. In other plantation crops (areca nut, cashew, tea, coffee, rubber and cocoa), there was increase of publication pattern in the initial 2 - 3 years, which almost stabilised in subsequent years. Oil palm publication seems to be fluctuating in their R and D focus yearly.

It can be said that India is undoubtedly a major contributor in the world, as its input to world's quantum of literature on the subject seem to be a continuous feature. There also has been a steady increase in its productivity pattern on plantation research. Hence, an in-depth analysis of the Indian productivity pattern on plantation crops has been undertaken in this study.

Subject categories of plantation crops in India

There are eight major categories of plantation crops, it includes: Coconut, arecanut, cashew nut, tea, coffee, rubber, oil palm and cocoa (Table 2). Table 3 distributes the quantum of Indian literary output against each of these eight subjects. Table 3 presents the quantum of records on plantation crops. Coconut accounts for 931 records, which tops the list amongst the others and literary contribution on oil palm is very low with 117 records to its credit. This data indicates that the total Indian literary output on plantation crops is 3283 records. Figure 3 reflect that amongst the plantation crops, coconut ranks high with 932 records (28%) followed by tea 657 (20%), coffee 526 (16%), areca nut 324 (10%), rubber 297 (9%), cashew nut 267 (8%), cocoa 163 (5%) and oil palm 117 (4%).

Chronological analysis of R and D output on plantation crops in India

An attempt has been made to assess the quantum of

Table 2. Quantum of plantation crops.

Plantation crops	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cocunut	273	47	198	197	245	206	200	208	307	236
Arecanut	4	29	32	37	45	44	35	32	38	31
Cashew	12	41	56	61	83	72	66	56	50	61
Tea	33	168	376	405	349	331	328	303	394	414
Coffee	14	201	317	348	376	347	303	476	329	491
Rubber	23	101	150	138	127	123	128	124	99	100
Oilpalm	9	67	113	203	83	101	97	117	72	82
Cocoa	25	94	130	154	134	153	97	137	145	159

Table 3. Quantum of Indian records on plantation crops

S/No	*Plantation crops*	*Quantum of records*
1.	Coconut	932
2.	Arecanut	324
3.	Cashewnut	267
4.	Tea	657
5.	coffee	526
6.	Rubber	297
7.	Oil Palm	117
8.	Cocoa	163
	Total	3283

records chronologically to identify the focus of R and D status on plantation crops research India, during the block periods of the study 1998 - 2007. Table 4 indicates that coconut literary output record is high followed by tea, coffee. It should be noted that, two of the plantation crops, oil palm and cocoa has low R and D Output.

Figure 4 shows research output of plantation crops in India. In 1998, plantation crops literature is very negligible except coconut. In 1999 and 2001 coconut publications are very negligible compared to other plantation crops. After few years, there has been steady increase of its publication in coconut. From 1998 onwards, upward growth of literature is seen in tea. Coffee, rubber, cashew nut, cocoa and oil palm publication seems to be fluctuating in their R and D focus yearly. Amongst the plantation crops, areca nut leads all through a decade.

Forms of publication

The Indian literary output on plantation crops have been analysed for its distribution pattern by the physical form of their publications. The physical forms, which includes journal article, conference paper, book chapter, annual report, thesis, editorial and others.

The journal articles are the chief carrier of plantation crops literature and the other forms of scientific communication are very negligible. Hence, in the subsequent section, these scientific journals are dealt in detail to identify the prime journals in the subject of Plantation Crops Journals.

The journals are ranked based on their frequency of occurrence. Since the ranked list is too long, the top ten of the ranked list of journal titles is provided in the Table 5

The Indian Coconut Journal published by Coconut Development Board, Cochin, Kerala ranks highest with the contribution of 317 articles and followed by Indian Journal of Arecanut, Spices and Medicinal Plants published by Directorate of Arecanut and Spices and Development, Calicut, Kerala. Among the top ten Indian journals, 4 journals are published from Kerala followed by Tamil Nadu and Karnataka (Table 6).

Authorship pattern

An analysis of the authorship pattern of Indian contributors of plantation crops literature revealed that individual authors produced the bulk of the literature. Further analysis of the authors in the field to identify the key/prime Indian contributors enabled to obtain the following findings: The top ranked author is identified to be Shri. Korikanthimath, V. S, affiliated to Indian Institute of Spices Research, Calicut, Kerala with 110 publications to his credit. Interestingly, out of the top 10, 5 authors are from Kerala and the remaining 5 are from Tamil Nadu

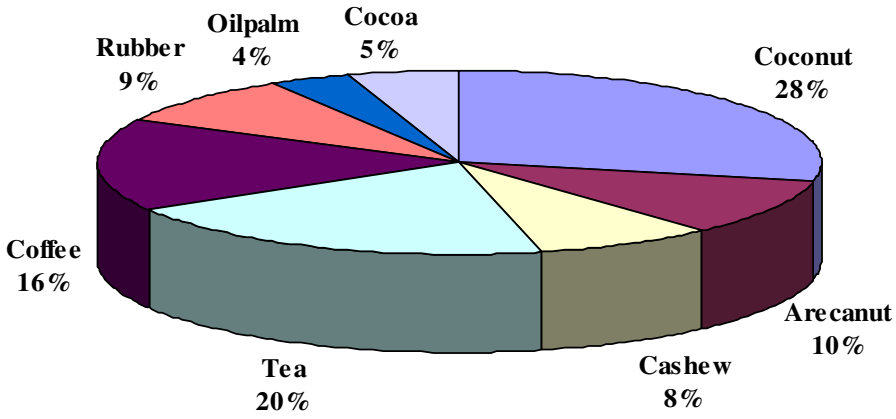

Figure 3. Indian contribution on plantation crops (1998 - 2007).

Table 4. Quantum of plantation crops vs year (India).

Years	*Coconut*	*Coffee*	*Arecanut*	*Oilpalm*	*Tea*	*Rubber*	*Cashew*	*Cocoa*
1998	113	1	4	2	13	15	2	2
1999	16	28	29	7	37	26	22	3
2000	118	53	31	11	61	37	28	24
2001	10	36	37	29	81	43	34	20
2002	150	46	44	12	70	41	50	25
2003	96	39	44	22	58	38	31	16
2004	80	47	35	12	87	33	31	22
2005	89	196	31	7	61	39	21	27
2006	155	43	38	8	99	14	28	14
2007	105	37	31	7	90	11	20	10
Total	932	526	324	117	657	297	267	163

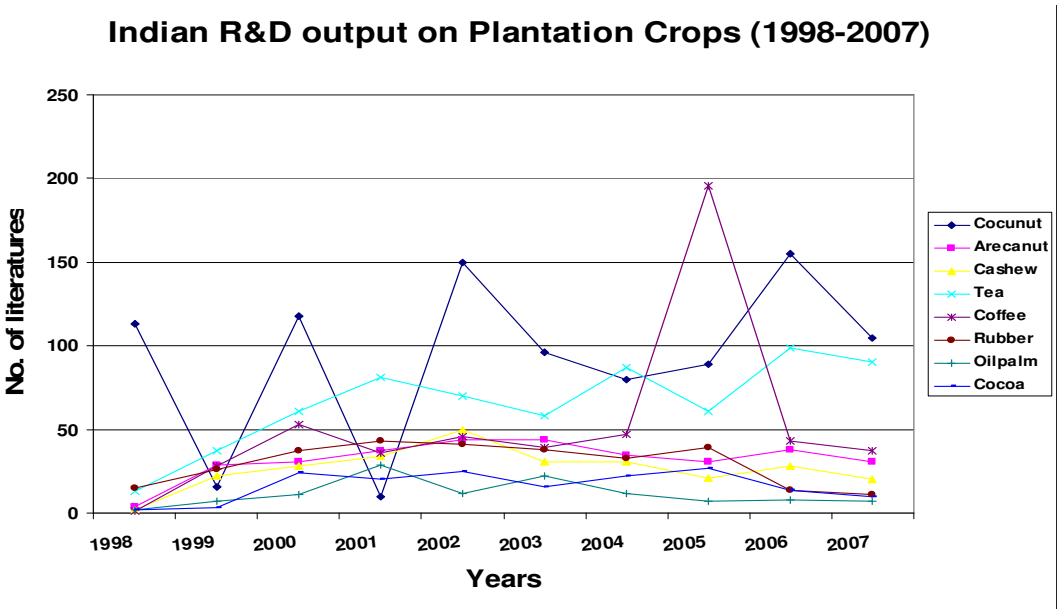

Figure 4. Year vs. plantation crops in India.

Table 5. Top ten Indian journals.

S/No	Journals	Publisher	Records
01	Indian Coconut Journal	Coconut Development Board, Cochin, Kerala	317
02	Indian Journal of Arecanut, Spices and Medicinal Plants	Directorate of Arecanut and Spices Development, Calicut, Kerala	288
03	Indian Journal of Natural Rubber Research	Rubber Research Institute of India, Kottayam, Kerala	238
04	Indian Coffee	Central Coffee Research Institute, Chikmagalur Karnataka	234
05	Journal of Plantation Crops	Central Plantation Crop Research Institute, Kasaragod, Kerala	135
06	South Indian Horticulture	South Indian Horticultural Association, TNAU, Coimbatore	72
07	Crop Research	Agricultural Research Information Centre, Hisar	69
08	Planters Chronicle	The United Planters' Association of Southern India (UPASI), Coonoor, Tamil Nadu	65
09	The Indian Journal of Agricultural Sciences	Indian Council for Agricultural Research, New Delhi	35
10	Current Science	Indian Academy of Science, Bangalore, Karnataka	32

Table 6. Top ten Indian authors and their productivity pattern.

Rank	*Top authors*	*Institutional affiliation*	*Total*
01	Korikanthimath V. S	Indian Institute of Spices Research, Calicut	110
02	Kumar N	Tamil Nadu Agricultural University, Coimbatore	46
03	Naidu R	Central Coffee Research Institute, Chikmagalur Karnataka	43
	Muraleedharan N	The United Planters' Association of Southern India (UPASI), Coonoor, Tamil Nadu	43
04	Thomas KK	Rubber Research Institute of India, Kottayam, Kerala	41
05	Kumar RR	The United Planters' Association of Southern India (UPASI), Coonoor, Tamil Nadu	39
06	Jacob J	Rubber Research Institute of India, Kottayam, Kerala	37
07	Edison S	Central Tuber Crop Research Institute, Thiruvananthapuram	36
08	Krishnamoorthy A	Indian Institute of Horticultural Research, Hessaraghatta, Bangalore, Karnataka	30
09	Tamil Selvan M	Directorate of Arecanut and Spices Development, Calicut, Kerala	26
10	Jayarama	Central Coffee Research Institute, Chikmagalur Karnataka	18

Table 7. Top 10 Indian corporate authors.

Rank	*Prime Institutions*	*Records*
01	Central Plantation Crop Research Institute, Kasaragod	286
02	Coconut Development Board, Cochin, Kerala	241
03	Rubber Research Institute of India, Kottayam, Kerala	157
04	Kerala Agricultural University, Thrissur	154
05	Central Coffee Research Institute, Chikmagalur Karnataka	141
06	Tamil Nadu Agricultural University, Coimbatore	136
07	The United Planters' Association of Southern India (UPASI), Coonoor, Tamil Nadu	130
08	Assam Agricultural university , Jorhat	60
09	National Research Centre for Cashew, Puttur	59
10	Central Tuber Crop Research Institute, Thiruvananthapuram	11

and Karnataka. The top 10 Indian corporate authors are listed in Table 7.

Since the list of corporate authors was very long. The top 10 alone are presented here. Amongst these 10 institutions, 6 are R and D units. Hence, it is identified that R and D units are the major contributors to the

plantation crops.

Conclusion

India is found to be the predominant country as it tops the rank list on Plantation Crop Research literature and the plantation crops are high value commercial crops of greater economic importance and play a vital role in the Indian economy. In 1998, plantation crops literature are very negligible except coconut. In 1999 and 2001 coconut publications are very negligible compared to other plantation crops. After few years there has been steady increase of its publication in coconut. From 1998 onwards upward, growth of literature is seen in tea, coffee, rubber, cashew nut, cocoa and oil palm publication seems to be fluctuating in their R and D focus yearly. Amongst the plantation crops, arecanut leads all through a decade. The Indian Coconut Journal published by Coconut Development Board, Cochin, Kerala ranks highest followed by Indian Journal of Arecanut, Spices and Medicinal Plants published by Directorate of Arecanut and Spices and Development, Calicut, Kerala. Among the top ten Indian journals, 4 journals are published from Kerala followed by Tamil Nadu and Karnataka. The Current Science is a general journal but it has occupied in the top ten list.

Scientometric approaches lead to trace the evolution of the discipline over time that marks the changes and cognitive shift within a discipline and topicality. Such assessments are on the way to become standard tolls of evaluation and analysis in science policy decisions. This paper on the chosen area of plantation crops R and D output will be brought to the attention and benefit of the plantation industry to redefine their research policies, programmes and priorities.

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