CHAPTER 4

RESEARCH DESIGN

4.1 INTRODUCTION

The Research Methodology is analytical part that adopts the detailed analysis of data using the range of scientometric and bibliometric techniques and formula along with standard statistical techniques. This study aims to illustrate quantitatively the literature growth in the field of Rubber Plant Research in Global and National level with the help of the source database Scopus. In this chapter, descriptions about the source database Scopus, bibliometric and scientometric indicators, statistic tools, systematic procedures and formulas of scientific literature outputs are provided.

4.2 THE SOURCE DATABASE - SCOPUS

The Scopus database produced by Elsevier is the world’s largest abstract, citation comprehensive bibliographic database covering Engineering and Technology of peer-reviewed literature. In addition, quality web sources with smart tools are used to track, analyze and visualize research. It has been designed to find the information of scientists and the researcher’s need. With quick and easy comprehensive, Scopus provides superior support of the literature research process. Scopus contains 46 million of records with 70% abstracts. It has nearly 19,500 titles from publishers worldwide and includes over 4.6 million conference papers.
4.3 APPLICATIONS OF STATISTICAL TOOLS

In this study, the following bibliometric & scientometric indicators statistical techniques and formulas are employed with the collected data on Rubber plantation research output from the Scopus database for 50 years study period 1967 to 2016

4.3.1 Relative Growth Ratio (RGR)

The Relative Growth Rate (RGR) has obvious features and it is one of the widely used techniques in the recent years to rate the growth. The Relative Growth Rate (RGR) is the increase in number of publications/Pages per unit of time. Hence, the mean relative growth rate $R$ (1-2) over a specific period of the interval can be calculated from the following equation (4.1).

$$R(1-2) = \frac{W_2 - W_1}{T_2 - T_1}$$

(4.1)

The explanation formula,

$R =$ Mean relative growth rate over the specific period of interval;

$W_1 =$ Log $W_1$ (Natural log of initial number of publications/pages);

$W_2 =$ Log $W_2$ (Natural log of initial number of publications/pages);

$T_2 = T_1 =$ Unit difference between the initial time and final time.

Therefore,

$R(a) =$ Relative Growth Rate per unit of publications per unit of time (Year)

$R(p) =$ Relative Growth Rate per unit of pages per unit of time (Year)
4.3.2 **Doubling Time (DT)**

A direct equivalence exists between the Relative Growth Rate (RGR) and Doubling Time (DT). If the number of articles or pages of a subject doubles during a given period, then the difference between the logarithms of numbers at the beginning and end of this period must be the logarithms of number 2. If natural logarithm is used, this difference has a value of 0.693.

Thus, the corresponding doubling time for each specific period of interval and for both articles and pages is calculated by the following formula (4.2), as suggested by Mahapatra.

$$\text{Doubling time } (Dt) = \frac{0.693}{R}$$  \hspace{1cm} (4.2)

4.3.3 **Degree of Collaboration (DC)**

The formula suggested by Subramaniyam is used. The Degree of collaboration is defined as the ratio of the number of collaborative research papers to the total number of research papers in the discipline during a certain period. The formula (4.3) expressed as.

$$C = \frac{N_m}{N_m + N_s}$$  \hspace{1cm} (4.3)

The explanation formula,
C is the degree of collaboration in a discipline.

Nm is the number of Multi-authored papers in the discipline published during a year.

Ns is the number of single-authored papers in the discipline published during the same year. Using this formula, the degree of collaboration is determined.

4.3.4 Time Series Analysis

Multivariate analysis technique namely, multiple regression has been used by the researcher. The purpose of using this technique is to predict the number of publications for the near future, which is 2025 and 2030. The year has been considered as the independent variable and number of publications has been considered as the dependent variable. The researcher has collected data for 50 years (1967–2016) and by using simple linear regression method projections are made. In this research, the Regression analysis has been applied to the concepts of authorship pattern, and quantum of publication output.

The Regression equation is,

\[ Y = a + bX \]

(4.4)

The explanation formula,

\[ Y \] is the dependent variable (number of publications), \( X \) is independent variable (The reference Year), and \( a \) and \( b \) are the constants.
4.3.5 The Collaborative Co-efficient (CC)

The Collaborative Co-efficient (CC) makes possible to draw a comparison between the different sub disciplines. In order to make a relevant comparison, the collaboration co-efficient among different countries has been examined by making use of Collaborative Co-efficient (CC) suggested by Ajiferuke (1988). Collaboration Coefficient is a number between 0 and 1. The more it is bigger than 0.5, the better is the collaboration rate among the authors. When it is near 0, it means that authors have weak collaboration. The formula (4.5) is given below used to calculating CC.

\[
CC = 1 - \left( \sum_{j=1}^{k} \left( \frac{1}{j} \cdot \frac{F_j}{N} \right) \right)
\]  

(4.5)

The explanation formula,

\( F_j = \) the number of authored papers

\( N = \) total number of research published; and

\( k = \) the greatest number of authors per paper

4.3.6 The Collaboration Index (CI)

This Collaboration Index (CI) is defined as (Lawani, 1980); this index gives mean number of authors per paper. It has no upper limit and cannot express as a percentage. The Collaboration Index (CI) is the simplest index presently used to explore the literature. It is to be interpreted the mean number of authors per paper and the formula (4.6) is given below:
\[ CI = \frac{\sum_{j=1}^{k} j f_j}{N} \]

(4.6)

Hence, \( j \) is the number of co-authored papers appearing in a discipline; \( N \) is the total number of papers in the discipline over the same time interval, and \( k \) is the greatest number of authors per paper in a discipline.

According to Ajiferuke (1988), this is interpreted merely mean. For the absence of an upper limit, there is no way of interpreting the numbers generated, and the method has imputed a non-zero weight to single-authored papers. To overcome this, index referred as the degree of collaboration is introduced, where single authored papers have zero weight.

4.3.7 **The Co-Authorship Index (CAI)**

The Co-authorship Index (CAI) is obtained by calculating proportionately the publication by single, two and multi-authored papers (Gargi & Padhi, 1999). Authorship values are categorized as single, two, three and more than three authors. \( CAI > 100 \) indicates that the number of publications is higher than the average.

The Co-Authorship Index (CAI) is to analyze the pattern of co-authorship index and it is explained below, for calculating Co-Authorship Index (4.7)

\[ CAI = \left( \frac{[N_{ip}/N_{io}]/(N_{o}/N_{io})} \right) \times 100 \]

(4.7)

The explanation formula,
Nij = Number papers with j authors in block i;
Nio = Total output of block i;
Noj = Number of papers with j authors for all blocks;
Noo = Total number of papers all authors and all blocks; \( j = 1, 2, 3, \geq 3 \)
CAI<100 indicates that the number of publications is lower than the average.
CAI=100 indicates that the number of publications corresponds to the average within a co-authorship pattern.
CAI > 100 indicates that the number of publications is higher than the average.

4.3.8 Author Productivity

The Author productivity is determined based on the number of papers contributed by the Scientists in a field. The analysis of author productivity enables to identify the extent of the contribution made by the researchers in a particular area of a subject.

4.4 CONCLUSION

The bibliometric, scientometrics indicators statistical tools and techniques are described in this chapter and they are used to analysis the data. The data collected from the source database, Scopus has been analyzed. In addition, the Growth of Rubber Plant Research in Global and National levels with the application of above explained bibliometrics, scientometrics indicators and statistical tools and techniques is also presented.

The Following chapter 5 will expose the details of Analysis and Interpretation of data.
Figure 4.1 Visual Representation of Structure of Rubber Plant Research Design