# TWENTY YEARS OF JOURNAL OF RUBBER RESEARCH (1996-2015) : A BIBLIOMETRIC STUDY

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# TWENTY YEARS OF JOURNAL OF RUBBER RESEARCH (1996-2015) : A BIBLIOMETRIC STUDY

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**A Dissertation Submitted As A Partial Fulfillment Of The Requirements For The Degree Of Master In Library And Information Science**

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## ABSTRACT

The position of the Malaysian Rubber Board (MRB) in rubber research and development is to develop, transfer, commercialise and promote research findings. The role of Journal of Rubber Research (JRR) published by the MRB in diffusion of data concerning researches in the field of rubber research and development activities is of premier importance. JRR is one of the oldest and leading rubber research journal in the country since 1929. Because of the JRR's maturity, productivity and its quality, therefore, this study presents a bibliometric study of the JRR from 1996 to 2015. The study covers the volume of articles, patterning of authorship, the extent of acknowledgement as included in research articles, types and frequency of occurrence. The results indicate that there is a consistent balance in the journal's publication productivity, with an average number of 21 articles produced per year, an average acknowledgment of 2.0 per item and the most common type of acknowledgements relate to the technical support. In terms of authorship pattern, results indicate multi-authoring and increased collaboration among rubber researchers. This study analyses the performance of scientists and productivity of researchers for the year 2007 until 2015 using the scientific output gathered by Web of Science (WoS). Data from WoS involves keeping track of the citation works and highlighting the impact and influence of the research journal. Citation to JRR articles were obtained from WoS which revealed that out of the 178 articles published between 2007 and 2015, 43.8% (78) have been cited from time to time. This implies that JRR articles are appealing to both local and international researchers as the study showed that these articles formed the source of knowledge in scholarly journals (158 times) and books or book chapters (11 times). JRR articles which are cited by top journals are *Journal of Applied Polymer Science (12), Rubber Chemistry and Technology (11), KGK-Kautschuk Gummi Kunststoffe (6)* and *BMC Plant Biology (4).*

## ABSTRAK

Peranan Lembaga Getah Malaysia (LGM) dalam penyelidikan dan pembangunan getah adalah untuk membangun, memindahkan, mengkomersialkan dan mempromosikan penemuan penyelidikan. Malah, fungsi Journal of Rubber Research (JRR) yang diterbitkan oleh LGM berperanan penting dalam penyebaran data penyelidikan getah dan kegiatan penyelidikan dan pembangunan (R&D). JRR merupakan jurnal yang tertua dan utama dalam penyelidikan getah Malaysia sejak 1929. Oleh kerana kematangan, produktiviti dan kualiti JRR, dengan itu kajian yang dibentangkan ini merupakan kajian bibliometrik JRR dari tahun 1996 hingga 2015. Kajian ini merangkumi jumlah artikel, corak pengarang, pengiktirafan yang terdapat dalam artikel, jenis dan kekerapan pengiktirafan. Keputusan kajian menunjukkan bahawa terdapat keseimbangan yang konsisten dalam produktiviti penerbitan jurnal, dengan jumlah purata 21 buah artikel dihasilkan setiap tahun, pengakuan purata sebanyak 2.0 setiap item dan jenis pengakuan yang paling umum berkaitan dengan sokongan teknikal. Berdasarkan corak pengarang, hasil menunjukkan dominasi penulisan berbilang pengarang dan peningkatan kolaborasi diantara para penyelidik. Kajian ini turut menganalisis prestasi dan produktiviti para penyelidik dari 2007 hingga 2015 denegan menggunakan output saintifik yang dikumpul melalui Web of Science (WoS). Data dari WoS melibatkan pemantauan kerja-kerja rujukan dan menonjulkan kesan serta pengaruh JRR. Artikel yang memetik JRR diperoleh daripada WoS mendapati bahawa daripada 178 artikel yang diterbitkan diantara tahun 2007 dan 2015, 43.8% (78) telah dipetik satu kali atau lebih. Ini menunjukkan artikel JRR menarik bagi penyelidik tempatan dan antarabangsa kerana hasil kajian menunjukkan artikel JRR menjadi sumber pengetahuan dalam jurnal ilmiah (158 kali), buku atau bab dalam buku (11 kali). Artikel JRR yang dipetik oleh jurnal-jurnal utama ialah *Journal of Applied*

*Polymer Science (*12*), Rubber Chemistry and Technology* (11*), KGK-Kautschuk Gummi Kunststoffe* (6) dan *BMC Plant Biology* (4).

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## TABLE OF CONTENTS

**CHAPTER 2: LITERATURE REVIEW**



**CHAPTER 3: METHODOLOGY**



**CHAPTER 4: DATA ANALYSIS**

**CHAPTER 5: DISCUSSIONS AND CONCLUSION**

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF ABBREVIATIONS

| | |
|---|---|
| **AGRIS** | International System for Agricultural Science and Technology |
| **CeRA** | Consortium for e-Resources in Agriculture |
| **DOSM** | Department of Statistics Malaysia |
| **EJUM** | University Malaya Electronic Journal |
| **EMS** | Editorial Manager System |
| **GDP** | Gross Domestic Product |
| **IIMA** | Indian Institute of Management Ahmedabad |
| **IRPA** | Intensification Research Prioritize Area |
| **IRSG** | International Rubber Study Group |
| **JRR** | Journal of Rubber Research |
| **JRRIM** | Journal of Rubber Research Institute of Malaya |
| **JRRIM** | Journal of Rubber Research Institute of Malaysia |
| **JnRR** | Journal of Natural Rubber Research |
| **LISA** | Library and Information Science Abstracts database |
| **LGM** | Lembaga Getah Malaysia |
| **MAPIM** | *Majlis Penerbitan Ilmiah Malaysia* |
| **MASTIC** | Malaysian Science and Technology Information Centre |
| **MOSTI** | Ministry of Science, Technology and Innovation |
| **MPIC** | Ministry of Plantation, Industries and Commodities |
| **MRB** | Malaysian Rubber Board |
| **MRE** | Malaysian Rubber Exchange |
| **MRELB** | Malaysian Rubber Exchange & Licensing Board |
| **MREPC** | Malaysian Rubber Export Promotion Council |
| **MRPRA** | Malaysian Rubber Producers' Research Association |
| **MRRDB** | Malaysian Rubber Research and Development Board |
| **NKEA** | National Key Economic Area |
| **NR** | Natural Rubber |
| **R&D** | Research and Development |
| **RiOS** | Rubber Information Online System |
| **WoS** | Web of Science |

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

This chapter covers the introduction, background of the study, statement of the problem, purpose, objectives, significance, and scope and limitations of the study. With regard to the background of the study, issues relating to the history of the journal, and the publication practice of *Journal of Rubber Research* is further discussed, justifying significance of the study. The aim and the significance of the study were highlighted to understand the approach in answering the research questions.

## 1.2 Research institutions as a journal publisher

Research centres are established with the objective of strengthening research activities, besides producing researchers of high calibre, capable of producing high quality research works which are recognised at national and international levels. In turn, the researchers in each research institutes play a role in conducting scientific investigations, experiments and related works namely, exploring, data gathering, building prototypes, leading to published information. Scientific and technical write-up is considered a research recording which provides the convenience to other researchers to study and to review the process and research findings to identify any mistakes, negligence, plagiarism or unproven information, if so arise. Scientific and technical writing is viewed as a product of the research process with which the researchers make known their research findings, and if these findings possess market values, can be translated into commercial products.

Research writings, upon being published, promotes the spread of knowledge in a continuous manner, and also serve as a source of references, providing a platform for debate among researchers. The very existence of research results helps spread the knowledge, both far and wide as remarked by Daniel Coit Gilman who was the First President of John Hopkins University. The research centres which are responsible to publish investigated works, play a role to further spread the knowledge and expertise of researchers to all over the world. In general, research centres play the role of promoting and disseminating their scientific findings to ensure that researchers are well-informed of existing research and methodology engaged in their fields of interest, avoiding copying of research write-ups and creating interest on the latest techniques.

Furthermore, the economic growth performance for each country also depends on the impact of the research and development (R&D). As a government research institution, MRB is keenly aware the importance of research and innovation (R&I) in contributing to Malaysian Gross Domestic Product (GDP) growth. According to Department of Statistics Malaysia (DOSM) on production of agriculture sector data, rubber industry continued to expand in 2015, with a contribution of 7.2 percent to the Malaysia's GDP. Research has been globally acknowledged for being catalyst to develop the knowledge economy and society. Quality research is of utmost importance to achieve excellence in career advancement for scientists. The Malaysia Best Publisher Award organised at national level by the *Majlis Penerbitan Ilmiah Malaysia (MAPIM)* is introduced to reflect the intention of country's leaders to develop academic scientific publications. Indirectly, this award encourages the publications of research findings of high quality and impact among the research centres in Malaysia. Encouragement and incentives as offered is an effort to recognise and appreciate all the academicians and researchers so as to produce excellent research work. This creates a healthy competition in the chasing of values and recognitions among the top researchers and becomes a

model and proof of their abilities in achieving the objectives and message of the organisation. Such distinguished achievements, upon gaining recognition and appreciations, inject spirit of motivation to be committed in sustaining high quality publications. According to Bassecoulard and Zitt (1999), in the publication system, observing national profiles of journals means monitoring the globalisation of scientific activity. Therefore, the process of measuring the performance and impact of the journal need to be carried out.

## 1.3 MRB as a research institution

Rubber research started from the early 1900 during British colonial rule. Initiative for rubber research in the early stage has been carried out in the research laboratories owned by private agricultural plantation company of Malaya such as Dunlop Plantations, Guthrie and Harrisons & Crosfield (H&C) Groups. The British continued to emphasise on rubber planting in line with the policy of agricultural development in Malaya at that time. Besides the RRIM, there are two other established agencies were in-charge with promotion and marketing work which are the Malaysian Rubber Research and Development Board (MRRDB) and Malaysian Rubber Exchange and Licensing Board (MRELB) to support RRIM. The MRRDB as known as Malaysian Rubber Research Development Fund was established by Act of Parliament in 1958 and responsible for a cess on rubber grown and administration of a fund for the purpose of financing research, development and promotion to increase or stimulate the production and consumption of natural rubber. The MRRDB was also responsible to ensure that natural rubber presents an accurate image in world markets, allowing it to be sold on its techno-economic merits. The role of the MRRDB in the promotion of industrialisation based on rubber is that of a catalyst. This function would be to generate industrial investments in Malaysia to expanded product manufacturing

capacity of the country, to increase value-added and job opportunities. As a premier research institution in rubber, the MRB is a prolific generator of scientific and technical information from its early days as the RRIM until the present. In 1962, a corporate body known as the MRE was established under the Malaysian Rubber Exchange (Incorporation) Act 1962 for setting up of a rubber market including a rubber exchange and for the promotion and regulation of the rubber trade and industry. Then, in 1972, the Malaysian Rubber Exchange (Incorporation) Act was amended to the Malaysian Rubber Exchange Licensing Board Act, 1972. It was given the responsibility of registering and licensing all persons engaged in the business of packing or shipping rubber for exports and the issuing licences to rubber dealers. Later, the RRIM, MRRDB, and MRE were merged in 1998 to form the MRB.

The MRB is one of six agencies that operate under the Ministry of Plantation, Industries and Commodities (MPIC). As laid down in the MRB (Incorporation) Act 1996, the main objective is to conduct research on natural rubber in liquid, solid or blended form originating from any latex producing plants. On the other hand, it also carries out research on synthetic rubber obtained from petrochemical products inclusive of all the elastomers from natural or synthetic rubber or both. The scientific work of the MRB will thus be directed toward establishing the facts underlying the cultivation and processing of rubber, to the discovery and application of fundamental principles for the benefit of the rubber industry. The MRB also disseminate scientific and technical information to the rubber industry and scientific communities. The MRB also assists the MPIC in charting future development with relevance to the rubber industry, bringing it to greater height. The MRB also involves in national programmes, governing rules and fields of research to accelerate the development and streamline the functioning of the rubber industry in Malaysia. MRB bears great responsibilities in various issues relating to the rubber industry, from production stage to end user stage. The MRB's

R&D contributions are mainly based on national context that is relevant to the local situation and solving local problems (rubber smallholders and rubber industry). As a government agency, MRB undertakes general collaboration with the industrial sectors to iron out various problems. In particular, MRB provide a constructive channel to gather inputs from industrial sectors on the existing market trends, product research and development. The MRB also plays an important role as an information provider on recent R&D for the benefit of the agricultural and scientific communities.

The MRB is established and functions under acts of government and is financed largely by the government. Funding for agricultural R&D is generated through a number of sources such as research grants under Intensification Research Prioritize Area (IRPA) programme under the Ministry of Science, Technology, and Innovation (MOSTI). The MRB is also financed through cess collection. The collection of a cess to pay for research on rubber was proposed by the industry itself and enacted into law by the British colonial administration in 1925. It was based on the quantity of rubber exported. The cess payments on research are intended to raise revenue to be spent in the rubber industry itself. Rubber cess has ensured that rubber research in Malaysia is well funded. According to Fuglie (2001), the reason behind the success of taxation being administered on rubber commodities arising from the fact that the private sector's involvement in the research works underlined by the commodity board. This is because most of the MRB Board members are representatives from the rubber industry, the government and private sectors. For this reason, the MRB is responsible to conduct research for the benefit of society. Hence, MRB has published its research findings under various scientific publications, especially the Journal of Rubber Research. The main purpose of this journal is to disseminate information to provide academicians, researchers as well as the general public on research undertaken by the MRB. Through

journals, a knowledge database is created to promote R&D activities which will help to enhance the competitive position of the country.

## 1.4 *Journal of Rubber Research* as a publishing vehicle for MRB

The role of scientific journals in the sharing of data concerning researches in the field of rubber research cannot be overemphasised. Journals constitute the primary source of information for researchers, and play a key role in information communication and dissemination. It should be noted that the articles appearing in peer-reviewed journals are seen as another means for researchers to share their research findings in the years ahead. These articles are subjected to the process of evaluation before being selected for publications. The selection is much needed to ensure the quality of articles is consistently maintained. The JRR is considered an official research publication of the MRB. It is also one of the oldest and leading rubber research journal in the country. It published original research articles and short communications focusing on areas that have close connection with the rubber investigations and its evolutions. The journal is created to cater for natural rubber and its underlying scientific scope, publishing articles from around the world, making known the rubber research findings to the scientific world. Most of the readers are rubber researchers from the academic bodies and governmental agencies as well as people within the rubber industry. Pradhan and Chandrakar (2011) observed that 'journals have been playing an important role in scholarly communication of different domain from the very past by containing the original thoughts, contents, ideas, views, research works and findings of researchers, scholars and academicians.' I have chosen the JRR as my area of research as it is a stable and mature publication, having been established since in 1929.

## 1.5. Background of the study

The contributing role of the JRR towards the knowledge and development of rubber research has been the subject of many articles (Tiew, 1998; Tiew and Kaur, 2000; Tiew and Sen, 2002). The introduction of JRR as an information source was enhanced by the good prospects of the rubber industry. As a matter of fact, rapid progress made in R&D of the rubber products is made possible with the continuous backing of ongoing research conducted both at the laboratory and industrial levels (Sombatsompop, 2009). Natural rubber or its scientific name known as *Hevea brasiliensis* Muell. Arg., since it was discovered and until now, has emerged as very important product. Generally, it is also one of the important materials which is available for making various kinds of eco-friendly products. Since it is an important and valuable material, it has been planted widely and is one of the most rapidly expanding crop in Southeast Asia. More than 75 percent global rubber production was produced by countries in Southeast Asia, such as Thailand (36%), Indonesia (26%), Vietnam (8%) and Malaysia (6%). The International Rubber Study Group (IRSG) estimated that the global demand for natural rubber during 2016 to 2018 would rise by 4 to 5 percent per annum, while the global supply of natural rubber would increase by a faster pace of 8 to 10 percent per annum (Thailand Industry Outlook, 2016).

In Malaysia, natural rubber (NR) has significantly contributed to Malaysia's export revenue and maintained its position as the leading producer of rubber gloves along with other niche products. According to the Malaysian Rubber Export Promotion Council (MREPC), the rubber glove sector was the largest export revenue generator for the Malaysian rubber product industry. It represents 73 percent of Malaysia's total exports of rubber product in 2015. The Malaysian government, with the help of the MRB is committed to propel the economy of Malaysia to high income level through revenues generated by the rubber industry. Furthermore, rubber sector is subsequently

categorised as a national strategic industry, being enlisted within sector under National Key Economic Area (NKEA). Through NKEA the sector aims to scale up Malaysia's market share of the global natural rubber gloves market to 65 percent by 2020, growing at an annual rate of 13 percent to maintain dominance as the world's leading rubber gloves producer.

One of the roles of the MRB is to modernise the rubber industry by developing technologies in improving productivity, processing and manufacturing of value-added, rubber based products for the benefit of rubber stakeholders. For these reasons, the MRB has encouraged research into the science and technology of rubber, natural rubber as well as synthetic rubber. This has led to over 1333 scientific papers published in the JRR from 1929. The MRB's research work on rubber has been the genesis of a number of important developments, especially in latex allergy, rubber clones, rubber biotechnology, advanced material and rubber product development.

### 1.5.1 History of the *Journal of Rubber Research* (JRR)

The *Journal of Rubber Research* owed its origin to the *Quarterly Journal of the Rubber Research Institute of Malaya*, which was first published in 1929. In 1931 the title was changed to the *Journal of the Rubber Research Institute of Malaya* (JRRIM). The Institute discontinued the publication on September 1941, due to the occupation of Japan in Malaya during the Second World War. In August 1947, the publication of the journal was back to normal. Starting from 1961, non RRIM authors started to be published in the journal, turning the journal into a distinguished periodical on natural rubber research. In 1974, the journal adopted the name *Journal of the Rubber Research Institute of Malaysia*. The journal later assumed the name of *Journal of Natural Rubber Research* between 1986 to 1997. Beginning from 1st January 1998, Malaysian Rubber Board was established upon the merger of Rubber Research Institute of Malaysia

(RRIM), Malaysian Rubber Exchange & Licensing Board (MRELB) and Malaysian Rubber Research and Development Board (MRRDB). Riding on that auspicious occasion, the journal underwent further renaming to *Journal of Rubber Research,* to portray its new corporate image and widening the subject scope. These changes were to meet new strategies towards meeting the changing needs of the rubber industry. From 2000 onwards the contents of the JRR covers all aspect of natural and synthetic rubber.

**Table 1.1: The JRR Changes in Title**

| Year | Journal Name |
|---|---|
| 1929-1976 | Quarterly Journal of Rubber Research Institute of Malaya |
| 1977-1985 | Journal of Rubber Research Institute of Malaya |
| 1988-1997 | Journal of Natural Rubber Research |
| 1998-current | Journal of Rubber Research |

The JRR is an international peer-reviewed journal in Malaysia focusing specifically on rubber. Articles were written by researchers from the MRB, other Malaysian institutions and also from overseas. Generally speaking, the journal focuses on publishing research findings and authoritative reviews on all aspects of rubber. The journal encourages contributions on various scientific disciplines relating to rubber R&D from institutions and organisations worldwide. The editorial board consists of 38 renowned rubber experts who will advise on the policy of the journal and act as consultants for evaluating the articles to be published. The journal has been indexed in many important databases namely, Science Citation Index Expanded, Journal Citation Reports/Science Edition, Scopus (Elsevier), Polymer Library (SmithersRapra), CAB Direct, AGRIS (International System for Agricultural Science and Technology).

### 1.5.2 Publication Practices of the *Journal of Rubber Research*

The JRR is published quarterly and accepts scientifically related research and periodic reviews from leading authorities on rubber related matters. Among research topics which have been published are genetics, plant breeding, selection and genetics, tissue culture and vegetative propagation, anatomy and physiology, exploitation: tapping systems and stimulation, microbiology, diseases, pests and control, rubber agronomy, biochemistry and biotechnology, chemistry and physics of rubber, technology of dry rubber and latex, rubber processing and presentation, rubber and latex product manufacturing, tyres, pollution, effluent treatment and utilisation. Those who are interested to publish in the JRR must submit their articles to Editorial Manager system (EMS) which can be reach at www.editorialmanager.com/jrubbres/default.aspx.

The EMS is established with the purpose of providing an online system for the researchers to submit their manuscripts. The entire process of submitting manuscript in JRR is performed by using the automated online EMS. It has been adopted by MRB's publication team as a solutions provider in monitoring, keeping track of journal publications as well as a channel for publishing and distributing research works. The process through which criticisms and comments are made by editorial board committee members helps to bring out the standard of the research articles. The editorial board are made up of professionals who are specialised and dedicated to accept the responsibility to give constructive comments and criticisms on behalf of the MRB. JRR's editor will harness this online system to study submitted works, redirect it the panel of reviewers and go through the process to take, look through, passing on, or discard the hand-written works. Selected reviewers are assigned to work through the manuscripts, which are subjected to acceptance or rejection. They also provide notice to editors on their service availability and specialities, send the tasks reviewed into the system. With the help of this system, the JRR can be published faster and in transparent manner.

### 1.5.3 Types of Papers JRR Currently Hold (http://www.lgm.gov.my/)

Information is taken from the Malaysian Rubber Board website. The types of materials accepted for publication are as follows:

**(a) Manuscripts**

Manuscripts are submitted online through the JRR EMS, and this is made possible with the guided instructions, right from registration to submission, as found in the webpage. This system enables the authors to view the progress of their manuscripts. Whenever the authors or reviewers are confronted with problems associated with the system, the online User's Guide and FAQs which are accessible through the Help option at the Login screen taskbar.

**(b) Short communications**

From the scientific point of view, a short communication paper may be used if someone is working with a hot topic and had discovered something never explored before in the literature. This is done to ensure that someone may be the first researcher to report this topic. In some research topic things go very fast and in some weeks another author can publish what someone has discovered. Short communications is commonly selected and published in JRR, because it is considered a concise report that is contributed for the importance of the subject matter. Generally speaking, the purpose of short communications is not to make known the preliminary results but rather to delve into topics that of special interest and has not been make known before. Short communication is generally limited to 2500 words. The format of short communication is as followed: i) General, ii) Title Page, iii) Financial Support, iv) Keywords, v) Present Address, vi) Abbreviations, vii) Abstract, viii) Introduction, ix) Materials and Methods, x) Results and Discussion, xi) Acknowledgements, xii) References, xiii) Tables, xiv) Figures, xv) Graph, xvi) Photographs, xvii) Drawings and graphs and xviii) Videos.

These are comments forwarded by the editor-in-chief or members of the board on current issues of particular interests in the JRR. The members of the current editorial board are listed in Appendix A.

### 1.5.4 Publication Requirements

Articles accepted are expected to adhere to the following requirements:

a) Written language

The language used is British English. The length should be around 15 pages and not exceeding 20 pages, including pictures.

b) Acknowledgements

Authors are expected to acknowledge grants awarded in aid of the study (if available), as well as persons who contributed significantly to the study.

c) References

References are numbered consecutively in the order in which they first mentioned in the text and use superscript number corresponding to the reference list whenever the reference is cited in the text.

d) Form of references

JRR adopted the Harvard Referencing System, numerical style with modifications to suit the MRB house style.

## 1.6 Statement of the Problem

The JRRIM was continued as the JnRR in 1986. With the change in title, the scope of the journal was expanded. The earlier JRRIM published mainly the results of research by RRIM staff, however the internationalisation of the journal has encouraged

more contributions on various scientific disciplines affecting natural rubber from the institutes and organisation worldwide involved in natural rubber research.

When the scope of the JRR has broaden, it gives the researchers more option to gain new knowledge and explore new field of research. By expanding the scope of JNRR's publication, it has attracted external researchers to collaborate and contribute their articles. JRR and its predecessors have been the subject of numerous analyses over the past 20 years. One of the investigations was by Tiew (1998) who has examined the JRR and analysed the underlying research work under local and international collaboration in the journals from 1987 to 1996. He found that trends were geared towards multi-authoring and collaboration among the natural rubber researchers. The percentage of collaborative papers among natural rubber researchers was quite high at 72.09 percent, with Malaysia topping the list in terms of international collaboration, followed by the United Kingdom, France, Thailand and Vietnam. This means that research collaboration is a normal phenomenon in scientific activity especially research on natural rubber. Since 2007, the journal is said to be covered and indexed by most of the international indexing and abstracting services. Zainab et.al (2012) traced and found that the JRR has been indexed by Scopus and Web of Science (WoS). However, there is a limitation in the study where the author did not take into account the impact (number of citation) of JRR in both indexing databases. The visibility of the JRR covered by the international indexing and abstracting services, leads to an enquiry as to how many articles in JRR have attained such 'visibility'. This study attempts to investigate these issues, since the JRR was added into the Web of Science (WoS), citation analysis is seen as one of the tools employed to measure the performance of a journal.

Broadly speaking, a citation is a quote of a part of the published or unpublished source (not always the original source). Based on Library Terminology

provided by Reynolds Library LibGuide website, referring citation is 'a reference to a book, magazine or journal article, or other work containing all the information necessary to identify and locate that work'. In other words a citation marks the entry in the bibliographic references section of the work to support and enhance the authors' point of view. Generally, a citation consists of in-body citation and the bibliographic entry. Citations play the key roles as followed: to maintain intellectual integrity(or avoiding plagiarism), to reckon the relevance of the reference sources to the prior or unoriginal work and ideas, to provide a platform for the reader to think in an unbiased manner whether the referenced material lends supports the author's argument as claimed, and to help the reader judge the adequacy and impact of the material the author has used. As Roark and Emerson (2010) have argued, citations provide the channels through which authors view the significance of their work, the relevance in the academic system, and the moral values, substance, and words. Bibliographies, and other compiled listings of references are generally not considered citations because they do not fulfil the right sense of the term, including the acknowledgements by other authors of the priority of one's ideas.

Research findings can be made known in many ways, namely through proceedings, reports, patents, book and journals. Out of the above sources, journals are considered the most popular way to share findings and present new knowledge. In bibliometric studies, citation analysis is a common technique. Gross and Gross (1927) were the first people to actually use the citation method. They used this method to evaluate the importance of the sources to a researcher. Tiew and Kiran (2000) conducted a study on citation analysis of the *Journal of Natural Rubber Research* from 1988-1997. Out of 250 research papers, it was reported that 4181 citations and 8 short communications were registered, with 16.2 citations per article. The study found that journals remain as the most relevant platform for making known and sharing of research

knowledge among rubber researchers with 3027 (72.4%) out of a total of 4180 citations. *Rubber Chemistry and Technology* is considered a journal with the most citations and 198 references. However, the top five most cited journals are Malaysian journals which are the JnRR, the *Journal Rubber Research Institute of Malaya* and the *Journal of Rubber Research Institute of Malaysia* (Refer to Table 1.1 in Section 1.5.1 for history of changes name of JRR). Currently, the JRR published in 1998 is expected to assume a leading role in the dissemination of Malaysian research results in the field of rubber. This present study aims to examine bibliometrically the JRR to access its performance as a national and also international journal. Citation analysis is used to recognise and analyse the new trends of the research sources in JRR.

Once JRR opens its door to international users to actually use their research, indirectly it promotes sharing of national expertise to outsiders. Researchers outside Malaysia can freely use and cite the JRR for their scientific work. Assessments to the process of the internationalisation of research institutions are implemented at different scales and through different activities to view its impact. One of the main processes to view the impact of internationalisation is based on the international co-production of knowledge (publications and technological outputs) (van de Besselaar, Inzelt and Reale (2012).

Scientific journal is an effective scientific communication because it contains permanent records of research. It is the most commonly utilised channels of communication among researchers. Considering the important role of the MRB and the research value of the JRR in terms of how to sustain rubber R&D activity, industry-driven where it has to be relevant to industry's needs and requirements. Therefore, a study on articles published according to issue volume and year need to be carried out. This study will help to establish the production trend of JRR and its underlying impact on rubber research sharing and referencing. For this reason, the evaluation of the JRR is

crucial to guarantee quality of MRB research and the quality of rubber science and technology in particular. Therefore, it relates to the importance of assessing MRB research activities through scientific publication patterns. Quantitative studies of publication patterns known as bibliometric, are useful indicators of scientific productivity, trends, and to assess the journal's status in knowledge advancement in the field of rubber research.

## 1.7 Purpose of the Study

Bibliometric studies on *Journal of Natural Rubber Research* has been studied by W.S. Tiew and Kiran Kaur in the year 2000. Since then, there are no publications about bibliometric studies on the JRR, particularly relating to it internationalisation and its performance (which can be measured by online citation analysis). *The Rubber Thai Journal* (Thailand) and *Jurnal Penelitian Karet* (Indonesia) do contribute towards the growth of scientific knowledge, and although they are part of the scientific community, their publication (on rubber) have never been studied. Now, with the latest information technology, it has become easier searching online journals through Scopus and Web of Science (WoS). By using these databases, literature searches for published research data can be done effectively and efficiently.

Web of Science (WoS) and Scopus are the main bibliographic databases to rank journals according to their productivity, impact factor (IF), status and research value (Chadegani et al., 2013). The JRR has been indexed by WoS and Scopus since 2007. JRR has proven to be of quality and authoritativeness when it was accepted by these indexing databases. Furthermore, since the distribution of these databases is worldwide, articles in the JRR are well-known and well recognised among researchers. Therefore, the JRR is considered influential or important to be studied.

## 1.8 Objectives of the Study

According to Zainab (2013), bibliometric studies carried out on a single journal sheds light on several characteristics of the authors. Firstly, through author characteristics, data regarding the author's profession, author's institutional names and types, authors' demographic database covering age, sex, income level, race, employment location, home ownership and level of education is covered. This information about the authors who make article contribution and the institutions with which they are affiliated is also useful to researchers. It also highlights the preferred authorship, foreign versus local contribution in terms of number and percentage, which is a good way to gauge how much a journal is being accepted internationally. Secondly, citation analysis enables citation count to be done on a journal in which the frequency of citations is quoted.

The motivation of doing this research is mainly grounded in the assumption that contributions of foreign authors in this journal as well as being included in WoS, are crucial towards internationalisation of the JRR. This investigation focuses on the international characteristics and impact of JRR, by analysing the geographical distribution pattern of authors publishing in JRR and to investigate the 'visibility' and performance of JRR in the WoS, during 2007-2015. In addition, research conducted is used for mapping rubber scientific research growth and to do a systematic analysis of publication output of MRB authors and other researchers. The study specifically focused on the following objectives, and to answer the following research questions:

a) To analyse the articles published in the *Journal of Rubber Research.*
b) To identify the quantity of articles sent for publications during the period of study.
c) To assess the scientific productivity of researchers over the studied period.

d) To identify the performance of *Journal of Rubber Research* in terms of citations received.

e) To highlight any other findings and contributions towards the internationalisation of *Journal of Rubber Research.*

Based on the following objectives, the research questions are:

1. What is the publication productivity of *Journal of Rubber Research* at the level from 1996-2015.
2. What is the authorship patterns of articles appearing in *Journal of Rubber Research* (in terms of):
   a) Degree of collaboration indicated by published articles using Subramanyam's formula;
   b) The country affiliation of contributing authors;
3. What is the content of acknowledgement in each article of the *Journal of Rubber Research*
4. What is the pattern of citations received by articles published in the *Journal of Rubber Research* through:
   a) Total citations received for articles published between 2007 to 2015 through the Web of Science;
   b) Format types of documents citing JRR; and
   c) Scholarly journals citing JRR between year 2007 to 2015.

## 1.9 Significance of the Study

When the JRR is studied bibliometrically, it became a more reliable and informative journal. The journal can be studied in the form of maturity, productivity and quality of JRR at national and international level. The journal being studied, to make inferences and to speak for authors who publish, reflects the research activity of their

institutions. The longevity of this journal indicates that Malaysia and rubber researchers recognised JRR has become a platform to be reckoned with for the research works to be presented, discussed, and explored for the betterment of the rubber research community.

Major indexing and abstracting databases such as WoS and Scopus are widely used as tool for the assessment of journals. Once JRR is covered by Scopus and WoS all items in it will be indexed and can be measured. Therefore, JRR is both influential and significant for a study to be carried out to establish the journal publication productivity; which is measured by the number of articles published by issues and volumes. This includes also the year which helps to interpret the publication profile over a certain time span. Hence assessing the role of the journal served as a platform for researchers to share, discuss and value add their research findings.

Next is the co-authorship pattern. As a matter of fact, the MRB has a long history of tying up the rubber sectors for the research and development works. This close rapport arises from a mutual understanding of each other's strength, capabilities and recognition with collaborative efforts, which result in greater achievements than working in isolation. JRR's article provides a background information with regard to the authors who publish their works under JRR. This information includes research institutes they are attached to, the collaboration level with other authors within and beyond the country. This data will shed light on the favoured authorship number, overseas contribution *vs* local contribution in terms of percentage, which will gauge the international recognition of the journal as the platform for further enhancing and advancing the rubber research works.

The content analysis refers to the analysis of acknowledgement, while the citation count concerns the citation performance reflecting the journal quality and prestige, journal consumption power, journal influence (JRR) to garner national and international contributions. The WoS is used for assessing the impact or significance of

a particular record for a certain time span using citation tracking and analysis. According to Mongeon and Paul-Hus (2016) the strength WoS initially, has the strongest coverage of natural sciences, engineering and also increasing coverage of older literature. It enables authors to know the number of citations under that author, or under a particular article. It even goes beyond the extent to link journals and authors who are involved in the same area of interest, to search for citations under a particular journal issue, volume or year as well as to examine the citations and work of other authors (Rew, 2009).

The purpose of this study is also to analyse the acknowledgements appears in the JRR. Since acknowledgement sections are a common element in the scientific community and is now a well-established feature of the scholarly communication process, JRR editorial community have also encourage the writers to include acknowledgement in their publication. Through acknowledgements, writers can convey their genuine gratitude for assistance, promote a capable academic and social identity (Hyland, 2004). Furthermore, the examination on the acknowledgement notes of the journals can also identify the related institutions or agencies that provide financial aids, grants or support to ensure that the research is carried out successfully. This assessment will be used as a reference for making decision-making by the government and agencies which are involved in providing financial aid as an effort to make the research projects successful. In addition, it would also help to assess the adequacy and evaluate the processes of funding allocation.

The study is expected to determine the JRR's international standing by revealing the nationality of the authors of papers published and the ratio of the papers contributed by multi-country authors and institutions between 1996 to 2015. Furthermore, this study also determined the number of research collaborations between MRB locally and internationally. Results from this study will contribute to better understanding about the

JRR's status in research output (papers) and citations (impact), so that MRB's competitiveness in knowledge production and intellectual impact among the rubber researchers can be identified. The findings of this study may be useful for MRB to continuously improve their quality of research.

## 1.10 Scope and Limitation of Study

The present study is conducted to examine a single peer reviewed journal, *i.e.* the *Journal of Rubber Research,* which is published quarterly by the MRB. Scope is confined to the 412 articles published within a 20 years period (between 1996 and 2015). The sample is retrieved from two online databases, namely RiOS (Rubber Information Online System) and WoS. These two databases are taken into consideration because they contain bibliometric information about the journal under study. Hence the study involved all articles, taking into consideration all bibliometric data appended to these articles including the article titles, authors and affiliations, and acknowledgement notes, while the WoS provides details on the citations received by JRR. All this information were compiled and analysed for making observations as indicated in the objective of the study. It would be interesting to see if this method can yield useful information about the development of the journal which has a long history of scientific information.

## 1.11 Organisation of the Dissertation

This study is divided into five chapters. Chapter 1 provides the background of the study, including the pertinent research questions and overall purpose. Chapter 2 consists of a review of existing literatures mainly from research articles and other resources. The review covers particularly the use of the variety of bibliometric measures in single journals. All articles and resources from the year 2010 to 2016 were

selected. Chapter 3 deals with the research methodology. The contents in Chapter 3 provide the methodology employed to solve the research problem, as mentioned in Chapter 1. Various techniques and procedures in bibliometric methodology which are applicable were used in this study. This approach involves the compilation of information and measurement of statistical data aimed at analysing the content and the structure of articles published in the JRR. This is followed by Chapter 4, which provides an analysis on the information collected, followed by a discussion of the research findings. This project concludes with consideration of the implications and limitations of the research, and suggestions for future research initiatives in Chapter 5.

# CHAPTER 2:

# REVIEW OF THE LITERATURE

## 2.1 Introduction

This chapter consists review of existing literatures mainly from research articles and other resources. The review covers particularly the use of the variety of bibliometric measures in single journals. To know which field of bibliometric to be employed in journals and what means are accessible to the researchers, this chapter concerns with academic literature review. All articles and resources mainly from year 1990 to 2016 were selected. Keyword searches such as 'bibliometric study on single journal', 'bibliometric indicators', 'international collaboration in single journal' were made primarily from several online databases such as SpringerLink, LISA (Library and Information Science Abstracts database), Emerald Full-text, Science Direct, and other open-source resources, namely the Google Scholar, BookSc and the University Malaya Electronic Journal (EJUM). My study sought to establish the academic articles publishing pattern of *Journal of Rubber Research* (JRR) from 1996 until 2015, using bibliometric approach. Thus, bibliometric has been applied to explore JRR trends and the scientific impact of the journal. There is a shortage of single journal bibliometric studies of scholastic publications worldwide. The aim of this review is to identify the scope of bibliometric measures available to researchers and make known the techniques employed for journal study. Some of the literature review represents the relevant studies pertinent to my research field are reported in the following section.

## 2.2 Overview of Bibliometric

Bibliometric is seen as one of the research means being applied in the field of library and information studies. Bibliometric refers to the quantitative measures of scientific literature for statistical purposes which are useful to describe the development

and situation of research, or in other words to find out research trends in many research fields. The terms of bibliometric were coined by Pritchard (1969),

"Bibliometric is the application of mathematical and statistical methods to analyse publication such as books and other media of communication in order to shed light on the processes of written communication and the transmission of knowledge,"

Typically, bibliometric methods serve three major roles which are, namely depicting, assessing, keeping in view of scientific and technological development. As a depicting instrument, bibliometric offers a detailed analysis of publication works at academic, state and national level. It is also utilised for making comparison for the journal productivity. In fact, in the last decades, bibliometric has turned into a standard instrument for managing science and research issues where it provides indicators to assess the growth and ranking of journal, hence establishing a foundation for assessing and aligning research and development output (Glanzel, 2003). Since their formal introduction in *Science Indicators 1972*, published by the United States by National Science Board, bibliometric indicators has grown steadily to measure scientific and technological achievement. This method is widely used by scholars when conducting studies on research output such as evaluation of publications and citation data analysis.

## 2.3 Bibliometric indicators

The indicators as found in bibliometric is commonly applied for deriving bibliometric findings. The word indicator as defined in the Oxford English Dictionary reads as: 'that which serves to indicate or give a suggestion of something; an indication of'

In the terminology released by the United Nations Development Programme Evaluation Office, there is another definition that matches the meaning of indicator as used in seem bibliometric (2002, p.101):

> "Indicator: Signal that reveals progress (or lack thereof) towards objectives; means of measuring what actually happens against what has been planned in terms of quantity, provides a simple and reliable basis for assessing achievement, change or performance."

Practically, fundamental bibliometric indicators are categorised in general by raw published articles and citation count in this study.

Quality indicators: used to gauge the production volume of a scientific journal writer.

Performance indicators: to gauge the how good a journal or the contributor.

Structural indicators: these help to establish a link between publication, authors and research fields.

Bibliometric indicators are applied to gauge the impact and quantity of research papers, and more commonly being used for research evaluation. The recoveries of research evaluation are worked out from the counting of research papers and the citations obtained from the total output of scientific investigations. Bibliometric indicators have long been employed at national level for science, technology and statistical writings to gauge scientific production volume and connectivity with world of science, both in developed and developing. Gonzalez-Brambila, et al (2016) have analysed production volumes of scientific research for nine developing nations, namely, Argentina, Brazil, Chile, China, India, Mexico, Poland, South Africa and Turkey. Their research found that these nations are closing the scientific gap with the more developed countries, doubling the rate of current world investments in research and development investments and the number of publications were more than tripling the rate of current world scientific research volume.

It is a well-accepted fact that bibliometric indicators are widely used in journal assessment at universities, public or private research bodies in comparing the performance of universities around the world, to assess the scientific qualifications for a

specific role. Olcay and Bulu (2016) in their study aims to explore the leading global university rankings using main indicators. One of the main criteria of the rankings were identified and measured which are scientific productivity, research quality, research impact and international collaboration.

Abramo, et al (2016) in their study have categorised top ranking scientists from Italy from over 200 research fields, by the research volumes. It then compiles the ranking of the related universities by the ratio of top scientists to their overall faculty. Lastly, the list was compiled then contrast with the ranking list by average productivity of the overall faculty. The analysis is conducted at the field, discipline and university levels. The paper also looks into the second question if the ratio of number of top scientists to the faculty has any bearing on the size of the university.

Kumar and Mallikarjun (2012) Indian Institute of Management Ahmedabad (IIMA), a management institute which is regarded as one of the oldest, and viewed as a renowned school of business in India. The IIMA is established for the recruitment of future leaders. Being reputed as an institute of distinction, on the contrary IIMA is inadequate in the amount of research journals, as used to be the case with many world famous research institutions. It is in this context that the present study aims to examine the research quantum of IIMA per journal publications as indexed in the Web of Science or Scopus for the past twelve years. The authors attempt to determine the patterns in research productivity from 1999 to 2010 , which takes into account of kinds of publications, most sought after journals, most productive authors from IIMA, patterns of contemporary communication, productivity and collaboration among the authors, the journals most quoted by the researchers from IIMA. The findings reveal several tendencies, i.e. more and more research papers are produced by IIMA from 1999 to 2010, the increasing joint publications among the researchers the decrease in single author and the multiple academic discipline approach to research at the Institute.

Aryati Bakri and Willet (2011) have analysed the computer science research in Malaysia by using bibliometric methods to assess the research accomplishments of Malaysian departments of computer science. The searching which is conducted on Wos and Scopus databases results in the identification of 508 and 748 publications that had been put to publications by the 1631 current academic faculties of the 19 departments. From their data, this study found that the registered publication rates are very low and reflecting the fact that most of the universities are purely set up for teaching purpose. It cannot be denied that very few publications made their appearances in prestigious journals or conference proceedings, and this is evident that much of the works have low impact, with the publications are cited 481 times (WoS) and 871 times (Scopus). Not many publications managed to receive non-trivial number of citations, and in particular in those high standard international journals. The performance is shown in a survey of international research in computer science (Ma et al., 2008), which rules out Malaysia as a high ranking research country. The counting of publication and citation indicates that Scopus handles better scope than WoS does, on analysis for that matter, nevertheless, the two data sources complement each other, with less than 50 percent of the great publications showing in both sources.

The most commonly indicators of scientific output are the number (quantity), type and distribution of publications. Output indicators such as the publication are the representing of the results and outcomes from the research process. Through the literature-based indicators, it is generally useful in research evaluations for the productivity of researcher in relation to the quantum of articles written by them. Since 2003, Malaysian Science and Technology Information Centre (MASTIC) has conducted a bibliometric study to establish present yield of scientific by local researchers. This study was conducted four times and was carried for every four years since 2003. One of the objectives is to measure the level of research output performance, to identify the

expertise of Malaysian researchers and to propose suggestions and make recommendations to policy makers which involve a systematic plan of action to rectifying Malaysia's Science and Technology production, so as to catapult the R&D activities to a higher level. Latest report by MASTIC on bibliometric study was published in 2016. The finding of the study showed the recorded Malaysia's paper output as 90,128 international articles and conference papers were recorded during the period of 2001 till 2014.

In Japan, Yamazaki (1994) has studied the state of research works in the domain of life sciences which are demonstrated by amount of papers published. A total of 5,107 writings from Japan, which made appearance in overseas journals published in 1989, obtained in ExcerptaMedica are selected. The results from this study have identified the ranking of Japanese medical research organisations in term of the total output of papers and paper contribution per head. This study found that the papers from universities authors are the highest contributors accounted for 80.5 percent of the 5,096 papers, followed by research institutes from national and private levels, accounting for 10.4 percent, and then followed by hospitals 5.15 percent, and lastly industry 4.0 percent. Based on paper output per head, this study shows the highest contributors from universities are Kyushu University, Faculty of Medicine, national and private research institutes are National Medical Center and Tokyo Metropolitan Institute Gerontology.

Royle and Over (1994) in their study present a bibliometric analysis of the papers as reported in the research write-up from three (3) universities in Australia. Education in Australian universities has set the rate of publication became a leading player in the development of related career development and has validity as a performance indicator. The study aims to gauge the research productivity of Australian academics using a performance indicator, namely Science Citation Index (SCI) and Social Sciences Citation Index (SSCI). Both SCI and SSCI will provide comprehensive

coverage of the most important journals in the world. Based on the investigations conducted on list of articles published in the research papers of three universities in Australia showed that only 27 percent of journal articles authored by academics in social science subjects are recorded by the ISI database, against 74 percent of journal articles written by the faculty members on scientific field.

A bibliometric investigation of agricultural written papers released in Malaysia between 1981 to 1990 was done by Nasir et al (1994). The investigation provides an understanding on the important journals from agricultural literature, on the types of published articles, with reference to the communication of research findings, on the topics which are well researched on, and those that have been not given attention, on the type of contributions made by Malaysian authors, on the code of practice of writing of conglomerate groups and on the amount of published papers each year.

## 2.4 Bibliometric studies on single journal

Many bibliometric works have been carried out on specific journal related with specific agricultural topics. This includes investigation on single authored specialised journal, in the area of agriculture. Also some studies that are closely related with my study will be reviewed below.

Bibliometric study on *Journal of Oilseeds Research* was presented by Kalyane and Sen in year 1995. They have analysed 498 research articles published during 1984 to 1992 in *Journal of Oilseeds Research*. This purpose of the study is to find out space allotment for full length of the articles, authorship pattern, author productivity, prominent contributors, important locations of oilseed research, citation pattern, and obsolescence of oilseed literature. Some of the important findings are the number of pages allotted per issue vary widely, single authored papers accounted for only 12 percent, two-authored paper are found to be maximum and account for 39 percent. The

places which are Hissar, Rajendranaga (Hyderabad), Bangalore, New Delhi, Kanpur, Dhajjad, Ludhiana and Pantnagar are found to be the important areas of oilseed research in India.

A bibliometric dissection of *Indian Journal of Agricultural Research* with reference to 602 articles during 2001 to 2010 was studied by Thanuskodi (2012). This investigation serves to explore the research output quality of agricultural researchers on agricultural related topics. In general, the investigation looks into the amount of articles, authorship types, subject type variation of articles, types of documents quoted, and yearly contribution of journals quoted. The study found that the data revealed that in 602 articles being studied, more than 93 percent articles are under joint authors while only 6.3 percent are under single authors. The results also indicated that a majority of contributions are from India which takes up 98.67 percent while the remaining 1.33 percent only from overseas contributors. Furthermore, the investigation pointed out the fact that the highest contributions came from universities contributing 168 articles.

Another single journal study was carried out in 2000 by Sivasubramanian. He has studied *Indian Coffee*, a monthly periodical released by Coffee Board Bangalore, India. The study aims to figure out that authors contributions are more towards domestic or abroad. This study analyses the authorship pattern, the scope and how frequency the reference are quoted examines annual distribution of articles. The results indicate that the trend is towards single authorship because a large portion of the write-ups were from single with 64.08 percent compared with two authors being 16.5 percent.

Ramesh and Nagaraju (2002) were carried out a bibliometric study on *International Journal of Tropical Agriculture* (IJTA), another Indian journal issued by Haryana Agriculture University. This study analyses 464 published write-ups put up in the journal from year 1991 to 2000. The authors used bibliometric indicators to figure out (a) quantity of articles put on publications, (b) pattern in which papers are written

under single author or multiple authors (c) level of teaming up in research writing, (d) degree of association among authors (e) the geographical position of the authors, (f) the number of words used in the articles (g) the amount of references made by the authors. The study found that (a) the quantity of articles sent for publication annually was not stable and registered a low count of 35 articles in 1998 to a high count of 64 in 2000. The results also found that authors teaming up in research writing was the trend (89.6%) and single authoring accounted for 10.3 percent. For the affiliation status of authors, this study showed that majority authors were from academic institutions (75%), and then from research organisations (19%) and lastly from government bodies (13%). This study also found that India authors were the majority contributors (87%), while foreign authors were contributed only 13 percent from Nigerian and Bangladesh.

Chanda Arya (2015) was behind the investigation in conducted a bibliometric study of 4,392 journal papers appearing in various journals from 2008 to 2012 which are appeared in the CeRA (Consortium for e-Resources in Agriculture) database. The analysis concentrated on the number of articles by year, authorship patterns, degrees of collaboration, contribution by institution, hierarchy of main contributors, geographical distribution of the authors at domestic and overseas level, subject development of research in plant pathology, and journal productivity patterns in plant pathological research. The research study discovered that out of 4,392 articles, single authors make up 3.26 percent of the articles while 95.99 percent of the articles demonstrated multiple authorships. The degree of collaboration has a mean value of 0.97. The major contributor comes from universities with the highest number of 3,383 articles. University of California topped in the ranking with 222 publications. For India, Uttar Pradesh contributed the highest quantity of articles (143). Meanwhile, at the international level, the United States has published the highest number of 1,980 articles.

The bibliometric analysis on a single journal is an encouraging domain of research of any field. In this kind of analysis, data is gathered from a single journal over a specific time and clearly investigated from different angles to determine the characteristics of authorship, citation bibliography, citation chronology and publications half-life, major authors, major journals, and impact factor of journals. One of the investigations on a single journal was from Swain (2014) who examined the publication patterns of *International Information and Library Review* from 2004 to 2013. The study found that the IILR has published majority of papers from single authors. Contributions from multi-authorship are found less, and the degree of collaboration is found to be 0.45 that indicated less intensity of collaborative trend of research.

Oyewusi (2012) studied the descriptive work of the *Nigerian School Library Journal* (NSLJ) from the year 1979 to 2010. This study takes on an elaborative research method, with the use of bibliometric analysis. The NSLJ was looked into the scope of topics, the physical location of authors, country of birth of authors, volume of published papers, teaming up among authors, noticeability in an international arena, sex of authors, kind of research, and language used in the articles. The noticeability of a journal was studied through Ulrich Periodicals Directory of the web-based version, Africa Journal OnLine (AJOL) and literature search. From the result obtained, the study indicated that there have been nine issues so far ever since the first issue was released in 1979. Notwithstanding, the study revealed NSLJ was not on the list as far as all the journals which are known in Nigeria. The geographical layout and authors' nationality in NSLJ pointed out that all are Nigerian authors and the degree of teaming up among the authors were low (16.7%), compared with the highest main contributor are from single authors (83.3%). The analysis also showed that many articles adopted the research design in the form of survey approach, accompanied by historical tactics, literature review and case studies.

Prabir (2013) make a study on 239 academic communications as kept in the inaugural five volumes of *Journal of Informetrics* (JOL) to investigate progressive development of the literary works, kinds of information transmission, characteristics of authors' partnership, trend of work jointly, prevailing sphere of research, etc. Eventual study concentrates on highly productive authors, level of cooperation and time-interval tendency. The study found that the articles production level doubles over the time frame under study as article printed increases markedly, with little doubt that single-authored contributions were relatively high (30%), a large portion of contributions were partnered by two authors (36%), whereas mean authorship takes up 2.28 per communication. Degree of collaboration (DC) was spectacular (0.699) but not significant enough as research partnership has started from 199 institutions of higher learning from 32 countries in the world. Prof. Egghe topped the list, with L Bornmann; R Rousseau and L Leydesdoff come next, in terms of quantum of contributions. Study shows there is an increasing tendency of using keyword with a mean of 4.55 per item, of which h-index, citation analysis, bibliometric, g-index, etc. prevails in an unexpected manner. Source journal of scholastic type has been further discovered with certainty based on rising citation and reference used tendency. Furthermore, increasing difficulty of the area has been ascribed to JOL due to growing use of tables and figures.

Swain and Swain (2013) serves to investigate scholastic information exchange in *Library Review* (LR) from 2007 to 2011 and to demonstrate the important features of the publication patterns. It conducts a detailed investigation for five volumes of LR from year 2007 to 2011 and utilises the essential bibliometric means to study a certain facets of publication trend for the specific time frame. The study found that articles written by only one author takes up the distinguished placing, denoting the predominance of standalone research in LR. The quantum of partnership in the production of this journal is determined to be 0.36. It is clear that LR has registered an

accommodation of 22 citations per article during the publishing period. With regard to the national production, the UK tops the chart, followed by USA and Nigeria.

Ramesh (2014) make a research on 366 scholarly research article published in the *DESIDOC Journal of Library and Information Technology* from 2003 to 2012. Analysis of surveyed mostly limited in its review of the pattern of distribution of journal articles, author, geographical distribution, authorship pattern and citation analysis. This study found a total of 147 articles are contributed in the journal was the two-authors, followed by 139 article as single-author. Geographically, the largest contributors among authors of India were from New Delhi, by contributing the fruits of article 199 of 627 from India.

Navaneethakrishnan and Kupesan (2014) in their study, focused only on the articles published in the *Sri Lanka Journal of the Humanities* published by the University of Peradeniya. A total of 319 records of articles released in the *Sri Lanka Journal of the Humanities* and authored by 147 authors during the period 1975 to 2009 were analysed in this study. The aim of the investigation was to study bibliometric characteristics such as distribution of publications, research growth rate, and authorship pattern in the journal. The study revealed that distributions of publications vary over the period of study and English occupies as dominant language. Research growth of publications was increased with positive indicators. Majority of the contributions were single authored. Author productivity varied between the observed percentage of authors and expected percentage of authors as predicted by applying Lotka's equation. Among the productive authors Peris, Merlin is in the top position with 26 contributions. In the ranked list of affiliated institutions, University of Peradeniya leads others.

Koley and Sen (2014) have analysed different bibliometric features of *Institution of Electronics and Telecommunication Engineers (IETE) Journal of Research*, from 2008 to 2012. Results indicate that the number of articles issued per volume is 60 on the

average, the highest ratio of single and multi-authorship is 1.11, Indian authors contribute 69.46 percent of the articles, foreign authors come up with 29.19 percent of the articles, but only 1.35 percent contributed jointly by both Indian and foreign authors. Approximately 14 references were quoted per article, which reflects the citation capability of the journal. Most of the references come from journal articles (57.68%). Shiban K. Koul, the leading contributor has come up with the most number of articles (33) from 2008 to 2012. The highest number of acknowledgements per article is 3 in 2008, and the lowest number per article is roughly 2 in 2009.

## 2.5 Evaluate international collaboration for the visibility of publications

Since 1960s, scientific collaboration has been systematically studied by researchers. In accordance to Patel (1973), participation in (collaborative) research is demonstrated by authorship and subsequently being named as sub–authorship. According to Patel (1972) scientific collaboration can be defined as '*a process of functional interdependence between scholars in their attempt to coordinate skills, tools, and rewards*'. Beaver and Rosen (1979) said one of the key elements in the productivity of research in any field is collaboration. Multiple-authorship is an indication of collaborative work. The idea of co-authoring lead to collaboration among authors, and the advantages are many. Katz and Martin (1997) indicate there are four fundamental benefits of adopting co-authorship as a gauge of collaboration including its substantiality, validity over time, ease of accessing data and ease of measurement. Co-authorship is seen as one of the most discernible and well chronicled forms of scientific collaboration. Virtually every facet of scientific collaboration networks can be consistently traced by studying co-authorship networks with the help of bibliometric methods. Smith was considered one of the foremost researchers to perceive an increase in the occurrence of multiple-author papers and to suggest that such papers could be

used as a substitute measure for collaboration among groups of. Smith (1958) studied 4,189 papers from *American Psychologist* put on publications between 1946 and 1957. He discovered that the average number of authors per paper grew from 1.3 to 1.7 over this period.

The significance of the multi-authorship on the noticeability of research results is an issue which has bearing in the context of evaluating and assessing scientific performance. Multi-authorship with researchers from various research organisations is a revelation of today's development of different spheres of human activities and a demonstration of the so-called 'internationalization of science'. Suarez-Balseiro (2009) studies the development of scientific connection at the domestic or global level, next how such connection determines the noticeability of the research findings reported by the research groups attached to the Puerto Rican institutions. Multi-dimensional indicators in general and multivariate analysis techniques, in particular, Factorial Correspondence Analysis (FCA), were applied to study and check the visibility of the papers published in core scientific journals. The results of the study demonstrates the formation and advancement of domestic and global co-authorship promoting the noticeability of the papers published and consequently can be considered to be a justifiable tactics in line with endeavour to accelerate research and development in Puerto Rico.

It cannot be denied that research scientists have been benefited greatly from intellectual exchanges with foreign counterparts and enjoyed costs reduction through sharing resources and technologies with other. Scientific collaboration has been systematically studied since the 1960s. Even every aspect of scientific collaboration can be reliably traced by bibliometric methods. Schubert and Braun (1990) in their comprehensive macro-studies of international collaboration in science have shown that the share of international co-authored papers dramatically increased during the two

decades. According to them, the share of internationally co-authored papers in the USA, USSR and Japan in the early of the 1980s lay significantly below 10%, but later by the end of the last century these shares reached and partly exceeded the value of 20%.

Besides boosting research performance, collaboration on a global level, may promote productivity and noticeability, although noticeability enhancement changes among countries and fields. In the last few decades, the strong connection between collaboration and scientific research productivity and academic impact has been investigated and recorded by Lotka and others. Generally speaking, collaboration creates positive impact on teams' productivity and capabilities, and cooperative scientific research outputs have significantly high academic impact, specifically those in connection with international collaboration. For example, the citations of a paper are partly in connection with the number of authors, institutions and countries taking part in the paper. Nonetheless, the outcomes are dependent on the type of collaboration and the collaborators involved. Furthermore, research by Narin, Stevens and Whitlow (1991) indicated that multiple-institution papers are more frequently quoted than single-institution papers, and papers with a foreign collaborator involved are more frequently cited than local papers. Glänzel (2001) demonstrated that the impact of global collaboration on national citation performance also changes significantly among countries. In certain cases, no advantage in quality being demonstrated for one or both partners, such as in some collaborations among developing or Eastern European countries. Meanwhile, the collaboration characteristics and influences on research productivity or academic impact also change by discipline. Hence, understanding the collaboration features of specific areas could notify the policies on partners' choice and research performance advancement, and could even lead to economic progress.

## 2.6 Bibliometric studies on rubber literature

The first and foremost bibliometric studies on rubber literature was issued by the publisher called John McGavack in the year 1972. He has compiled and published a list of 100 top rubber scientists who contributed to the world's rubber literature for the year 1932 to 1970, which were obtained from a sum total of 56,296 rubber research publications. The listing was decided not only on the total number of publications, including patents, but on the number pages represented by articles and by the total number of authors: collaboration tend to diminish an author's standing. MRPRA scientists average 73 papers each in the list (including papers published prior to joining and after leaving the services of MRPRA). From the list, the study also found that more than 50% of rubber scientists were Americans who were the major contributors to the rubber research publications.

In 1983, Kanesan Solomalai of Rubber Research Institute of Malaysia studied 1931 number of references under the rubber physics from 1940 to 1981 to investigate the development, financing, dispersion, productivity and citation characteristics of authors. It was observed that rubber physics literature experienced an accelerated growth particularly from 1955 to 1981, with a doubling time of eleven years and yearly growth rate of 6.2 percent. The study showed that from 1962 to 1967, the growth of rubber physics literature reached maximum, accounting for 19 percent of the total literature. On the other hand, MRPRA made up 28 percent of the total rubber physics. Nonetheless, from 1968, other parts of the world, and not MRPRA, contributed towards the major growth of the literature. The contribution by academic groups to rubber physics literature chalked a higher accelerated growth rate in relation to other research and development centres. Malaysia, on the contrary, set an example in providing financial support to rubber physics research from 1946 to 1970, while previously USA was the leader. English is the main language medium used in rubber physics, which

accounted for 75 percent of the literature total. Overall, the distribution of literature did come close to a Bradford-Zipf distribution and the existence of a Groos' effect showed an unfulfilled part of the literature. There was a spread of 5.6 papers per journal and the contents of journals of rubber physics were geared towards rubber chemistry and technology. The investigation also showed that *Journal of Polymer Science* was the most well received journal, which accounted for 10 percent of the journal articles. Based on Lotka's law, author productivity was –2.5 and 72 percent of the authors contributed one paper only. Meanwhile, research collaboration showed an average of 1.8 authors per paper. Lastly, rubber physicists accounted for a great segment of the global rubber literature and rubber physicists have a great tendency to do self-citation.

*Journal of Rubber Research* has been studied bibliometrically by researchers a few years back. Tiew (2000) analysed the *Journal of Natural Rubber Research* (JnRR) put to publication by the Rubber Research Institute of Malaysia from 1988 to 1997. This journal was indexed in Chemical Abstracts, Excerpta Medica and also in Biological Abstracts. The study concentrated on the scope of journal and author self-citation. A large portion of the submission (53%) to the journal carried self-citation and 40 percent of the articles had at least one journal self-citation. The average score of journal self-citation was 8.4. A large proportion (33.2%) of authors cited themselves at least once and 23 percent of authors cited themselves twice. The study also shed light on problems from references and raised the non-uniformity in citing Chinese and Malay names. Tiew remarked that this could be prevented through a comprehensive guideline to authors.

Then, JnRR was re-examined again by Tiew and Kiran (2000), using the same set of articles but concentrating on authorship pattern and citation analysis. Out of 256 articles being studied, the average number of citations was 16.2. The degree of referencing was highest for journal articles (71.8%), followed next by monographs

(13.11%) and conference proceedings (4.1%). Most articles were multi-authored papers (72.1%) as compared to single-authored paper (27.9%). The literature which were in the period from 1978 to 1987 registered the highest number of citations (55.7%).

JNRR was again investigated by Tiew and Sen in 2002 and this time the bibliographic data being looked into was the types of acknowledgement and occurrences in articles. The acknowledgements were classified using Cronin-McKenzie-Rubio typology. The study observed that acknowledgements were rather a familiar sight in the area of rubber studies as 74 percent of articles has been added in acknowledgements. The type of acknowledgement commonly found was the technical support (26%), gratitude for access to facilities (15%), for giving moral support (13%), for financial support (12%) and clerical support (7%).

N. Sombatsompop et al (2009) analysed 7,457 documents on natural rubber published by rubber scientists during 2002 till 2006, which were retrieved from Science Citation Index Expanded (SCI-Expanded) and SCOPUS database. The objective of this investigation was to look into whether the contributions of natural rubber publications are related to the results of productivity-export capacity for the period 2002 till 2006. The study found that natural rubber publication had contributions shares more than half of all rubber publications. From this study, it indicates that there is no direct connection between the productivity-export volumes and the quantum of natural rubber publications.

## 2.7 Reference to scientific publications (Citation analysis)

Generally, the assessment of scientific activity with regards to the use of citation analysis or citation counts are considered as a useful indication influence of the research to the wider scientific research community. Tracking citations – the number of citations received can be used to evaluate the impact of the research articles, a researcher, a

research centre or bodies or a journal. The studies on citation characteristics led Eugene Garfield (1961) to the creation of one of the most useful bibliographic tools Science Citation Index (SCI). The important aspect in the citation analysis is to determine the citation impact. According to Garfield (1972) 'citation frequency reveals the impact of a particular publication or scientist'. Citation performance of the journal is summed up as journal quality and prestige. In other words, it will involve the application of the journal citation measures. According to Smith (1981) citation analysis is best described 'as the evaluation and interpretation of the citations received by articles, scientists, universities, countries, and other aggregates of scientific activity, used as measure of scientific influence and productivity'.

Citation analysis was used in many investigations, in particular, to assess scientific journals and scientists (Narin, Pinski, & Gee, 1976; Jan, 2009; Guz & Rushchitsky 2013) for appraising research quality for university's ranking (Moed et al. 1985; Van Raan 2005; Buela-Casal et al. 2007; Abbot & Doucouliagos 2003), and for the evaluation of national research performance (Moed, De Bruin & Van Leeuwen 1995). Citation analysis is being applied more and more to substantiate the significance of scientific papers and the journals where these research findings are turned into publications (e.g., impact factors).

Jones (2004) has presented his study about the application of citation analysis and to verify the impact of *Journal of Analytical Toxicology* (JAT) publications and its scientific elite as demonstrated in the most productive authors and the most frequently cited papers appearing in the journal. This study is confirmed to all JAT articles issued from 1981 to 2003, using citation database. This database was used to collect information about the most productive authors of articles showing in JAT, the articles with the highest citation, the relationship existing between the co-authors, and the countries where the work originated from. The results indicates that the person

mentioned most frequently as an author was E.J. Cone, who authored or co-authored 69 papers that garnered a total of 1432 citations, getting a citation impact of 20.76. Nonetheless, the article cited most in JAT was a solo-author work from 1981 by M.E. Jolley depicting a fluorescence polarization immunoassay in analysing therapeutic drugs in plasma, with citation counts up to 184 times. Researching and writing in groups can improve the output of scientific articles as illustrated by the Institut de MecineL~galein Strasbourg with P. Kintz as the prime mover. Kintz and his partners produced their research mostly in the form of collaboration effort and published in JAT.

Kolle, Shankarappa & Ho (2016) have analysed the 781 articles of high citation in the SCI Expanded of category of horticulture issued from 1961 to 2014. Articles of which has been cited above 100 times, after being published since 1961, are evaluated based on their circulation in the journals, and citation life cycle. Additionally, this study appraised quality status of authors, institutions and country. *The Journal Theoretical and Applied Genetics* and *American Journal of Enology and Viticulture* were more prolific journals. A majority of the highly cited articles issued in 1990s and 2000s, respectively. Number of authors per article with an average value increased steadily from 1960s to 2000s, respectively. University of California, Davis and Cornell University in USA take up the top two positions in terms of the most productive institutions, meanwhile USA and the UK were the two countries producing the most articles. The citation life cycles of the articles of high citation indicate that most of the highly cited articles had chalked up less citation in early stage, but eventually received higher number of citations in the later stage.

Using citation analysis on single journal has been studied by few researchers. Sanni and Zainab (2012) examined *Medical Journal of Malaysia* (MJM) publication from 2004 to 2008. They adopted citation analysis to study sources of reference employed by medical authors from Malaysia in MJM. The objective of their studies

was to examine article and author productivity, age of references used and impact of the journal. They concluded that among the sources, journals made up 87.67 percent of the publication format employed by authors and researchers from the medical field. The study found that out of the total 580 articles published by MJM, 76.8% (446) have been cited one time or the other. In general, MJM articles received more citations from authors from East Asia, followed by Europe and Southeast Asia.

Zainab, Anyi and Anuar (2009) have studied 272 articles issued by *Malaysian Journal of Computer Studies,* from 1985 to 2007. This study observed that out of a total of 4634 citations in the 272 articles and determined that the average citations per volume ranges from 8 to 25 citations, with an average of 17. The number of citations registered in MJCS apparently to be quite alike to other scientifically related fields and the authors found that most of the papers used a wide variety of information sources. Articles in journal were the most frequently most cited resources which contributed to 1794 (38.71%) citations, followed by books (1216, 26.24% citations), and lastly conference papers (1116, 24.08% citations). The authors found that there was a decline in book's citation after year 2000 and a rise for conference paper's citation from 1993 onwards. Other reference sources such as web resources has been found fairly small but, from year 1996 onwards there were increased usage among the computer technology researchers.

Wohlin (2009) has conducted a study employing the ISI Web of Science to pinpoint the most cited articles in software engineering journals on year 2000 and in the last 20 years. The aim of this work is to establish and create listing for the most influenced articles based on citation count. The outcome of the study was presented with a list of the 20 articles cited most. From this result, the top ranking authors from highly cited articles have been invited to contribute to a new article for a special issue of the journal. With this study, the author intended to acknowledge the articles which

were appealing and representing the most authoritative in the software engineering research. It can be seen as a possible recommendation for students and researchers to read since the articles cited most in the last 20 years.

## 2.8 Summary of Chapter Two

This chapter has presented and highlighted findings from the literature review which are conducted as part of the research framework. Specifically, it provides a conceptual and informative review of the literature on bibliometric study. Considering the objectives of the current study, this chapter discussed the overviews of the bibliometric theory which was coined by Pritchard (1969) that provided knowledge about the application of bibliometric for statistical purposes.

# CHAPTER 3:

# METHODOLOGY

## 3.1 Introduction

Research methodology is considered a logical and systematic approach to tackle a research problem of interest. It is regarded as a science about how a research is being conducted. In short, it constitutes the governing rules by which researchers depict, explain and predict phenomena which are called research methodology. It is important to highlight here that there is a difference between a research method and research methodology. Research method is concerned with finding a solution to the problem. However, research methodology is about finding an explanation with regard as followed,

(i) Why is a specific research done?

(ii) How is a research problem being formulated?

(iii) What kinds of data were gathered?

(iv) What specific method has been used?

(v) Why was specific technique of analysis of data employed?

It is important for the researchers to know the research method in general and the research methodology in particular. For instance, it is required of him how to come up certain tests, how to compute the mean, mode, median or standard deviation, how to perform certain research techniques, but they need to know the relevance of each of the techniques, and what they mean and what indications the techniques provide.

The contents in Chapter 3 provide the procedures used in making systematic observations such as obtaining data, or information to achieve the stipulated goals for the study. This study adopts a selective bibliometric methodology to examine JRR. Various techniques and procedures in bibliometric methodology which are applicable will be used in this study. This approach involves the compilation of information and measurement of statistical data aimed at analysing the content and the structure of articles published in JRR. Therefore, through bibliometric studies, the quality and quantity of publications produced by rubber researchers can be measured. The objectives of the study are:

a) To analyse the articles published in the *Journal of Rubber Research.*
b) To identify the quantity of articles sent for publications during the period of study.
c) To assess the scientific productivity of researchers over the studied period.
d) To identify the performance of *Journal of Rubber Research* in terms of citations received.
e) To highlight any other findings and contributions towards the internationalisation of *Journal of Rubber Research.*

## 3.2 Bibliometric as a Research Method

Bibliometrics is defined as 'the application of mathematical and statistical methods to the study of bibliographic data' (Merriam-Webster Online Dictionary). Bibliometrics is madeup of two parts, namely, 'biblio' means books and 'metrics' means measurements. According to Lewison and Devey (1999), the traditional approach used by bibliometrics focuses on publication counts and citation counts of individual papers. The productivity of journals is determined by the publication count

whereas the significance of publication is reflected by citation count. Bibliometric study adopts a two-pronged approach, descriptive and evaluative (Leeuwen, 2005). Descriptive method concerns with the counts of the contributing countries, authors, journals, year of publication and disciplines. On the other hand, evaluative approach deals with the literature usage count, of which attempts are made to study the use of a body of literature by using citation analysis. In general, the objective of evaluation is to maintain the quality of scientific publications which is known as scientific visibility.

Bibliometrics involves conducting statistical analyses of publications such as publication measures. Bibliometrics is now commonly used to analyse research by performing quantitative studies on the publications. In general and in the practical sense, bibliometrics is based on the reason that most of the research discoveries will be published as articles in the international research journals. Consequently, these articles will be referred, read and studied by other researchers. Researchers from all over the world will refer to the writings of the previous authors as a reference for their research investigation The more referencing being received by a journal, the greater the impact being reflected on the journal. Investigation which is conducted on JRR stresses on a few types of usage of bibliometric measuring methods. Among the measuring methods available, the stress is made on their use to measure the article productivity or total article output which involves computing the total of the articles printed based on issue, volume and year. This is useful for making conclusion with regard to the publication trend over a period of time and to project the influence of the journal as a research findings dissemination tool for the rubber researchers in particular. Each and every author who contributes research works under JRR will subsequently be measured under author's institutional names and countries. This helps creates a picture or demographic profile of the authors who contribute to the JRR and to their countries of origin. Subsequently, the profile of the author will make known the distribution of the

contributing authors by country published in the JRR. The percentage of foreign *vs* local contributions can reveal the internationalisation status of JRR. Furthermore, this study can also determine the capability of JRR in attracting Malaysian as well as foreign authors to publish in the JRR especially researchers from rubber producing countries. To measure the impact of JRR, citation analysis is one of most common methods used in bibliometric studies. Citation analysis is considered an important tool to trace research works of academic scholars, gauge impact and justify tenure and decide on fund provision. Bauer and Bakkalbasi, 2005 state that citation analysis makes it possible for researchers to monitor and gauge the development and influence of an article through time. They can check all the references that other author cites by looking backward and then forward it to those authors who then cite the article. Undoubtedly this brings up the publishing profile of the author.

### 3.3 Data retrieval

This study was based on data obtained from two databases named Rubber Information Online System (RiOS) and Thomson Reuters' Web of Science (WoS). Rubber Information Online System (RiOS) is considered as an information portal system developed by LGM library which functions as an access gateway for the digital source and service on connection with the working staff of LGM and rubber industry supporters in particular. All fully textual documents under JRR publications for research are downloaded for assessment. Hence, the articles are organised based on the year of publication under RiOS system. RiOS facilitates the process of accessing the articles for research purpose. Undoubtedly, RiOS is an all in one information portal for the MRB. Undeniably, this database is an institutional repository, which is serving as a central collection and repository centre for all MRB publications. This investigation was based on these databases as a source of data, due to the fact that it covers the period of years

under study and has features that provide relevant information needed for this study. This study considered all research articles derived from JRR in RiOS and is limited to the years 1996 to 2015. For each publication, the data obtained are as followed:

- Data concerning with the authors who have contributed in JRR;
- Addresses of the contributing authors;
- The data source organised under year of publication and volume number
- The title of the publication;
- Acknowledgement

Moreover, data was being collected on all publications processed by Thomson-Reuters citation database citing JRR publications during the period 2008 till 2015. The citation database is organised under three citation indexes, namely Science Citation Index, Social Sciences Citation Index and Arts & Humanities Citation Index. A Journal Citation Report was created for JRR in this database that include:

- A list of citing publications (both with and without self-citations)
- The total number of citations
- The average number of citations per article
- The researchers' h-index.

Thomson Reuters' WoS database is one of the main commercial indexing database which covers selective mainstream journals considered to be of high quality, prestige and have high impact value (Szarina 2003, Belew 2005, Lokman & Yang 2007, Chadegani et al 2013, Bornmann & Mutz 2015). WoS is recognised as an established online academic database that provide access to the world of journals by employing the indexing search. It also acts as a tool for studying research achievements and shedding

light of emerging research trend. The remarkable characteristics of WoS database renders the process of data gathering and extracting is the underlying reason for the choice of this database. The citation index caters for two types of data;

(a) what has been published by authors in particular area and

(b) the citation obtained by the works published.

It is understood that from 1996 to 2015, a period of 20 years would reflect a pretty good projection on the development of publications and is bound to provide quantitative evidence on the impact of the rubber research field. Therefore, this source has found to be very valuable in bibliometric studies, with regard to international science (Szarina, et al, 2003). This particular issue was also brought to light by Haiqi and Yuhua (1997) who concluded that the citation indexes made available in the WoS enables bibliometric studies to be conducted through tracking author's references as put in the bibliographies of published papers. The data tracked can be compiled to provide uniqueness of publications and productivity associated with countries of the authors.

### 3.3.1 Handling of bibliographic records

Preceding to bibliometric analysis being conducted, several steps are to be taken in the sourcing and preparing data as input for processing into useful information. For this study, in an effort to explore the characteristics and trends of articles published in *Journal of Rubber Research*, a total of 412 articles from 1996 to 2015 were collected for analysis. For each article, the procedure to perform the bibliometric analysis boils down to the following three steps:-

1. Identify the data such as author's name, number of authors, their institutional affiliations and address, and acknowledgement notes to be recorded.

2. Examine those publications which are either single authors or multiple authors, authorship trend and collaboration patterns. Allocate the publications to national and foreign authors.
3. Identify the impact of JRR from year 2007 until 2015 using indexing database. The data analysis will focus on the application of the bibliometric indicator associated with highly cited publications, (HCPs). This citation based indicator gauge the research distinction by identifies the top-notched papers in a specific field. For this analysis, it identifies the top four out of the 169 indexed papers as sourced from WoS.

The data obtained from bibliometric analysis is subjected to a series of processing namely compilation, recording, tabulation and analysis using Microsoft Excel files and worksheets. The software capabilities in mathematical formulation were fully applied to formulate and create various tables and graphical presentations to represent the findings. In addition, the data entries were tabulated, re-tabulated, verified, re-checked and reviewed to yield the most accepted output. Table 3.1 illustrates MS Excel files and worksheets created. The worksheets files were created for each year, which contains data for the growth rate of articles by year, authorship pattern of articles, the degree of collaborations, authors' ranking list based on geographical locations, and analyses the acknowledgement.

**Table 3.1: MS Excel Files and Worksheets Created**

| Spreadsheet | Data fields | Task | Information Retrieved |
|---|---|---|---|
| **Sheet 1** | Article Title | Attach unique codes to each title | Unique code |
| | Acknowledgement | Identify number of articles acknowledging funds or assistance | Assign each acknowledgement notes based on category of acknowledgement |
| **Sheet 2** | Authors | Identify single or multi - author | Local vs Local / Local vs Foreign / foreign vs foreign |
| | | Affiliation of authors | |
| | | Obtain Collaborating affiliations | Local vs Local / Local vs Foreign / foreign vs foreign |
| | | Number of co-authored papers<br>Obtain number of co-authored papers (if any) | Number of co-authored papers per year and proportion of co-authored papers by applying Subramanyam formula |
| | | Number of collaborating affiliations:<br>Identify two or more collaborating affiliations per article | Names and country of collaborating affiliation |

The data for the citation pattern comprises records retrieved from WoS online database. Search was limited to JRR indexed in WoS. The search yielded 169 records for the period 2008 to 2015. The retrieved data has been extracted as CSV file.

### 3.3.2 Handling multi-authored works

Authors are important entities in a system which is concerned with the creation of knowledge, and also the generation of information, its communication and consumption. Authors not only contribute to the production of new scientific knowledge, but they also influence many other aspects related to and concerned with the information production, dissemination and use. For this reason, any kind of investigation aimed at studying the group of authors and their behaviour is likely to yield useful data. Certain assumptions are made to understand communication patterns within rubber researchers, for example, co-authorship are necessary for examining the potential impact and the visibility of the JRR. Visibility of JRR can ultimately be translated to an increased opportunity for attracting citations. According to Buella-Casal et al (2006) the competency of a journal to garner research collaboration at international level is regarded as a useful and widely studied criterion. Collaboration among authors at international level is evaluated by co-authorship indices that furnish details about the percentage of co-authored papers at international level relative to total publication output of a journal. The emerging trend of foreign participation in papers published in JRR is studied with the purpose of determining its degree of international acceptance. There are two means to establish the level of internationalism of scientific journals to be considered:

a) the characteristics of the authors in terms of physical locations.
b) co-authorship connection (proposition of co-authorship within and beyond the country )

In order to analyse the geographical distribution patterns of authors, each article has been identified based on geographical reference at the country level. The physical locations of the authors were determined by the address of the authors affiliated to.

Starting from the year, each article was assigned with the country of which the article is dealing with. Each article with more than one author will be selected and column was tabulated according to institutional affiliation. Single contributors were assigned a value of one. For a publication with multiple contributors were assigned full counting. For instance, a publication joint-written by authors from four different countries, it is counted as a complete publication by each respective country. In this study, full counting was selected to measure each author has a weight of one and has given the same weight. The purpose of the full counting is for the computation of research productivity. Based on this indicator, it can be used to present and compare publication activity, such as to express the number of publications per country.

It has long been realised that the co-authorship of articles in journals will provides a window on collaboration patterns within the scientific community. Price (1963) on the basis of survey of Chemical Abstracts observed steady trend towards multiple authorship. Co-authorship of a paper can be thought as a documenting under a collaboration between two or more authors. The collaboration has formed a 'co-authorship network'. The structure of the co-authorship network can demonstrate many interesting features of scientific communities. Scientific collaboration can also be considered as a means for the enhancement of scientific visibility and productivity. The scientific collaboration networks were tracked by analysing co-authorship of 412 published articles in JRR between 1996 and 2015. Three different identifications are made for the publications, firstly, publications published under an institution as 'no collaboration', secondly publications which are contributed jointly by institutions from two or more different countries as 'international collaboration', and thirdly publications contributed jointly by the local institutions as 'national collaboration'. These types of joint publication are non-interrelated. MRB's publications under both national and international collaboration have been collected.

### 3.3.3 Handling data from Web of Science (WoS)

It is a well-accepted fact that the world today has entered into an age of information explosion. At the same time, a huge number of research publications from various scientific spheres are produced. These publications are also growing increasingly technical and specialized, making qualified reviewers more and more difficult to find. Under this context, it is important to identify and employ a database which can perform literature searching an effective and unbiased manner. One of the most comprehensive and versatile research platform which is introduced by Thomson Reuters as WoS. This database provides a single destination which makes accessing to the most reliable, integrated and multi-disciplinary research platform possible. In addition, to carry out literature searching, WoS assumes the role of establishing the hierarchy of journals from the aspects of productivity and total citations earned to determine the journal's appeal, acceptance by other researchers, or respect. According to Quint (2006), WoS provides the facility to enable researchers to carry out evaluation of records based on citation data. Unquestionably, citation tracking determines the frequency that a specific piece of work, writer, article or journal that has been quoted to by similar publications.

All bibliometric indicators build on the idea that we can measure the impact of a paper by counting the number of other papers that have cited it. Citations, the theory goes, act as a vote of confidence or a mark of influence from one paper to another. The fact that one paper cites another is an indication that the cited paper has had some influence, or impact, on the paper citing it. Counting the number of citations received by a paper, then, allows us to measure the impact that paper has had on science as a whole. Citation tracking furnishes full details for other writers or academic bodies that are researching on same subjects and highlights works published under related areas of research. It is assumed that the JRR are being well communicated within the rubber

researchers. The data for this purpose was collected from one of the indexing database known as the WoS. The number of citations received by a paper in JRR cannot measure whether or not the research reported by that paper improved the research. It can only measure whether or not the paper was useful to other authors for writing their own papers. This is a form of impact, to be sure, but not necessarily the one that reviewers think they measure.

Strategies of data retrieval:

Access to the Web of Science database from University Malaya's Library databases and select the Web of Science™ Core Collection to reach the database.

The basic strategies are below:

a) Basic Search and key in Journal of Rubber Research, and select Publications Name to retrieve the data is chosen
b) Timespan are from 2007 to 2015.

To find the most cited articles on the JRR, choose Analyze Results and Create Citation Reports. The report provides a wealth of useful information including graphs of items published per year and citations per year, average citations per article and the total number of times the articles has been cited.

### 3.3.4 Acknowledgement patterns in Journal of Rubber Research

This study attempts to look into the acknowledgement included in 412 research papers and short communications in the JRR during 1996 until 2015. All the articles were captured through to find the acknowledgements. These acknowledgements were than examined, categorised and analysed from different perspectives thereof were tabulated. Based on observation from each article, the acknowledgement is indicated with more than one acknowledgement. Hence, counting of the number of

acknowledgements per article is carried out and multiple acknowledgements of the same category in an article were considered as one.

To support the classification of acknowledgements, the Cronin-McKenzie-Rubio typology has been used. According to them, for the acknowledgments may for one reason or another, either tangible or intangible, often they boil down the so-called 'intellectual debt', which is beyond payable. On the one hand, citation indexing is a proven tool in assessing research contributions, on the other hand, acknowledgements plays the complementary role of citations in the auditing of academic works. Cronin, Shaw & La Barre (2003) have categorised six types of acknowledgment, namely, supports in terms of moral, financial, editorial, presentational, instrumental/technical, conceptual or peer interactive communication (PIC).

### 3.4 Analysis of Data

After the stage of data collection for the present study, it thus entered the next stage of data analysis. Data itself conveys no meaning unless it is analysed, processed, tabulated and interpreted and results drawn from it. Data was analysed in accordance with the requirements of objectives of the study. The basic purpose of statistical analysis is to summarize observation of data that they provide supporting answers to the hypotheses or research question. Hence, the related data was grouped at one place, counted and analysed to come at certain conclusions. Firstly, tally method was adopted for analysing the data. Separate slips were made for analysing, and information contained in earlier slips was noted down on these slips according to the requirement. The goal of conducting the data analysis was to find meanings in the raw data collected from the articles of JRR and provide answers to the research questions.

Various methods have been proposed to calculate the degree of research collaboration. This study also concentrates on scientific collaboration and its measurement by indicators. The formula given by K. Subramanyam (1983) was defined as the ratio of the number of collaborative research papers to the total number of research papers published in the discipline during a certain period of time. Research collaboration in this study will be specifically reflected by co-authorship.

- To study the trend in collaboration and co-authorship in JRR
  a) using the formula given by Subramanyam, the extent of collaboration researcher can be measured by:

     Degree of collaboration C = Nm / (Nm+Ns)

  Where,

  C = Degree of collaboration

  Nm = Number of multiple authors

  Ns = Number of single authors

  This value of C, along with the weighted average number of authors per paper, gives a fairly clear idea of the extent of collaboration in a rubber research.

## 3.5 Summary of Chapter Three

This chapter has explained and outlined the research method employed in the course of this study. The source of data, the method and approach were dealt with. The subsequent chapters will focus on data analysis and presents the overall findings resulting from the experiments.

# CHAPTER 4

# DATA ANALYSIS

## 4.1 Introduction

In chapter 4, results were obtained from data analysis, then research findings are discussed and presented. As a matter of fact, the study is guided by findings of which the research problems are based. Data analysis helps to answer the four research questions below:-

1. What is the publication productivity of *Journal of Rubber Research* article from year 1996 till 2015.
2. What is the authorship patterns of articles appearing in *Journal of Rubber Research* (in terms of):
    a) Degree of collaboration indicated by published articles using Subramanyam's formula;
    b) The country affiliation of contributing authors;
3. What is the content of acknowledgement in each article of the *Journal of Rubber Research*
4. What is the pattern of citations received by articles published in the *Journal of Rubber Research* through:
    d) Total citations received for articles published between 2007 to 2015 through the Web of Science;
    e) Format types of documents citing JRR; and
    f) Scholarly journals citing JRR between year 2007 to 2015

## 4.2 Article productivity of *Journal of Rubber Research*: 1996 – 2015

*Journal of Rubber Research* was first published in 1928 as one of the premier scientific journals in Malaysia. It has a wide coverage on rubber research in general. The number of research articles has grown steadily. According to Tiew and Kaur (2000) in their study has found that an average of six (6) articles were published in *Journal of Natural Rubber Research* between year 1988 to 1997. Under the present study, the growth rate of articles published in *Journal of Rubber Research* from 1996 to 2015 was investigated. Output indicators as measured by the quantity of articles published and manifested by the results and outcomes of research process. Generally, the output indicators through the literature-based indicator are useful in research evaluations, highlighting the researcher's productivity in terms of the quantity of articles delivered. Four hundred and twelve articles are put on publication over the twenty years period (412). The highest number in article publication was recorded in 1997 and 2000 with 24 articles, followed by 23 articles in year 1996 and 1998 as shown in Table 4.1. The study is based on information from Rubber Information Online System (RiOS) http://rios.lgm.gov.my/cms.

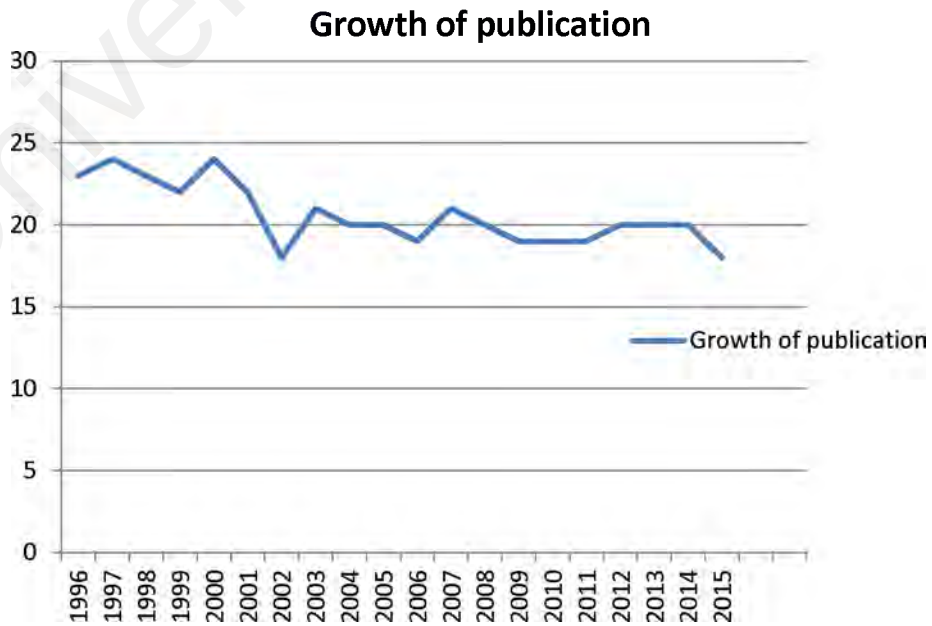


**Figure 4.1: Growth of Publications**

**Table 4.1: Number and Percentage of Articles Published in *JRR* per year**

| Year | No. of Articles | Percentage (%) |
|---|---|---|
| 1996 | **23** | 5.58 |
| 1997 | **24** | 5.83 |
| 1998 | **23** | 5.58 |
| 1999 | **22** | 5.34 |
| 2000 | **24** | 5.83 |
| 2001 | **22** | 5.34 |
| 2002 | **18** | 4.37 |
| 2003 | **21** | 5.10 |
| 2004 | **20** | 4.85 |
| 2005 | **20** | 4.85 |
| 2006 | **19** | 4.61 |
| 2007 | **21** | 5.10 |
| 2008 | **20** | 4.85 |
| 2009 | **19** | 4.61 |
| 2010 | **19** | 4.61 |
| 2011 | **19** | 4.61 |
| 2012 | **20** | 4.85 |
| 2013 | **20** | 4.85 |
| 2014 | **20** | 4.85 |
| 2015 | **18** | 4.37 |
| **Total** | **412** | 100.00 |

Table 4.1 presents the number and percentage of articles published in *Journal of Rubber Research* per year. In the period from 2001 to 2015 there is a clear decline in the number of articles and it shows that the growth rate is on the down trend. Figure 4.1 displays the graph for all records of *Journal of Rubber Research* from 1996 to 2015. The growth in numbers of JRR's articles has declined since 2001, and the highest number in article publication was recorded in 2003 and 2007 with 21 articles, followed by 20 articles in year 2004 to 2005, and 2012 to 2014 as shown in Figure 4.2.

## 4.3 Scientific collaboration

In any fields of research, collaboration among researchers are significant towards the development and sharing of research findings. According to Fox and Faver (2011) said an increasing collaboration among specialists brings about more multi-authored papers of higher research quality. Collaboration among agencies at national and international level is integral to the development of MRB. Malaysia was once the world's number one producer and exporter of natural rubber, but now it has lost its position to Thailand and Indonesia. In order to keep the industry growing and safeguarding the interest of rubber players, all the rubber producing countries have continued to work together. Locally, there are a number of research institutions in Malaysia, for example, Malaysian Palm Oil Board, Forest Research Institute of Malaysia, Malaysian Institute of Road Safety Research (MIROS) and all of them are related to the industries directly or indirectly. It shows that collaboration among research institutes in Malaysia plays an important role in enhancing scientific and technological development in industries in general and in the industrial development of the country. In this study, the collaboration patterns among researchers from the rubber research field is analysed based on the co-authored articles in the *Journal of Rubber Research*. Co-authorship is a trend that illustrates there is an increasing discussion, teaming up and influence among the researchers. Thus, the understanding of the relationship is of paramount importance to assess the degree communication among the research scholars. The bibliometric measures can reflect collaboration among agencies at national and international levels.

The different collaboration types are identified based on CWTS Bibliometric Report (2015). The collaboration types examined on the basis of address information in each article.

- No collaboration: the publication carries the identity of ~~a~~ research unit or a university. The publications may carry one or more contributors.
- National collaboration: the identities in the publication come from two or more institutions from the same country.
- International collaboration: the identities in the publication come from two or more countries.

**TABLE 4.2: Collaborative research among MRB researchers and other institutions in Journal of Rubber Research**

| COLLABORATION TYPES | MALAYSIAN RUBBER BOARD (MRB) | OTHER INSTITUTIONS | TOTAL |
|---|---|---|---|
| International Collaboration | 65 | 33 | 98 |
| National Collaboration | 34 | 61 | 95 |
| No Collaboration | 65 | 100 | 165 |

The table 4.2 (above) quantifies the output of scientific collaboration of Malaysian Rubber Board and other institutions. The table shows how collaboration is a quite common activity for most of the rubber researchers. It also reveals the type of collaborative research in rubber as found in Journal of Rubber Research 1996 to 2015. The result indicates Malaysian Rubber Board's researcher have carried out 34 research projects with local institutions or agencies, and 65 research projects with foreign institutions. Rubber researchers from other institutions were also found active in doing collaboration. It was found that rubber researchers from other institutions are collaborating at national level, involving as many as 61 research projects, whereas at international level, involving as many as 33 research projects.

### 4.3.1 International collaboration and counting of research papers

The counting of research articles based on internationally collaborated paper is fundamental to show each country's respective contribution. In counting publications, the counting method for collaborative papers - use **Whole Counting (WC)**: full credit to all contributors. It is also called as normal or standard counting. For example, an article with three addresses of which two are from India and one from Malaysia, both the countries receive one full credit. This counting method was selected to give equal credit to all contributors. Based on data from Table 4.2 (previous page), here the rank of country is reported. A total of 25 countries, contributed 98 articles by 204 authors. As shown in Table 4.3, the distribution of country ranks was presented. Malaysia ranked first in its paper production (65 papers), followed by United Kingdom (29 papers) and Japan (22 papers).

**Table 4.3: Country Ranks based Whole Counting Procedures**

| Country Rank | Paper counts (Whole Counting) | Country |
|---|---|---|
| 1 | 65 | Malaysia |
| 2 | 29 | United Kingdom |
| 3 | 22 | Japan |
| 4 | 18 | France |
| 5 | 13 | Thailand |
| 6 | 12 | United States |
| 7 | 5 | Ivory Coast |
| 8 | 5 | Netherlands |
| 9 | 4 | Vietnam |
| 10 | 4 | Belgium |
| 11 | 4 | India |
| 12 | 3 | Indonesia |
| 13 | 3 | Brazil |
| 14 | 3 | Cameroon |
| 15 | 2 | China |
| 16 | 2 | Singapore |
| 17 | 2 | Sri Lanka |
| 18 | 1 | Austria |
| 19 | 1 | Australia |
| 20 | 1 | Canada |
| 21 | 1 | Finland |

| | | |
|---|---|---|
| 22 | 1 | Pakistan |
| 23 | 1 | Poland |
| 24 | 1 | Saudi Arabia |
| 25 | 1 | Scotland |

### 4.3.2 Authorship patterns

Authorship pattern of the articles is presented in the Table 4.4 and Figure 4.2. The study reveals that, of the total 412 articles produced during the period under study, only 57 articles (13.83%) were single authored. Joint authorship by 4 and more authors have the highest frequency of 151 articles (36.65%) followed by 3 authors with 117 articles (28.40%). Thus, multi-authored articles far out-numbered single-authored articles, comprising 86.17% of the total articles studied. In the sample studied, the one and only research article with the most number of authors is '*Occurrence and characterisation of mycoflora in soil of different health conditions associated with white root rot disease in Malaysian rubber plantation*' co-authored by eleven researchers mainly from Malaysia and only one from Poland.

**TABLE 4.4: Authorship patterns per year**

| Year | Single | Joint | Three | Multi | **Total Articles** |
|---|---|---|---|---|---|
| 1996 | 2 | 8 | 8 | 5 | 23 |
| 1997 | 5 | 10 | 5 | 4 | 24 |
| 1998 | 2 | 6 | 5 | 10 | 23 |
| 1999 | 5 | 7 | 7 | 3 | 22 |
| 2000 | 1 | 6 | 5 | 12 | 24 |
| 2001 | 3 | 1 | 9 | 9 | 22 |
| 2002 | 4 | 2 | 5 | 7 | 18 |
| 2003 | 1 | 3 | 11 | 6 | 21 |
| 2004 | 0 | 2 | 7 | 11 | 20 |
| 2005 | 6 | 3 | 3 | 8 | 20 |
| 2006 | 5 | 3 | 7 | 4 | 19 |
| 2007 | 5 | 1 | 5 | 10 | 21 |
| 2008 | 2 | 3 | 9 | 5 | 19 |
| 2009 | 1 | 4 | 3 | 11 | 19 |
| 2010 | 5 | 7 | 3 | 5 | 20 |

| | | | | | |
|---|---|---|---|---|---|
| 2011 | 1 | 6 | 8 | 4 | 19 |
| 2012 | 3 | 5 | 5 | 7 | 20 |
| 2013 | 2 | 3 | 5 | 10 | 20 |
| 2014 | 1 | 5 | 4 | 10 | 20 |
| 2015 | 3 | 2 | 3 | 10 | 18 |
| Total no. of authors | 57 | 87 | 117 | 151 | 412 |
| Percentage (%) | 13.83 | 21.12 | 28.40 | 36.65 | 100.00 |

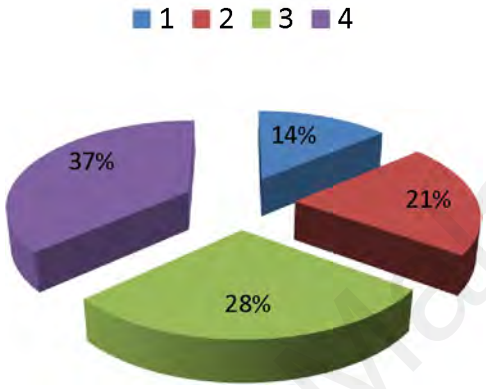


**Figure 4.2: Authorship pattern**

### 4.3.3 Contribution by Malaysian and Overseas Researchers based on Affiliation

The ranking of authors by geographical affiliation can also serve to gauge the impact of the journal (Zitt and Bassecoulard, 1988). Illustrated in Table 4.5 based on country is the number of contributors from Malaysia and oversea countries. All in all, 40.87 percent (210) of the authors are affiliated to Malaysia, on the other hand, 59.1 percent (304) are from foreign countries. In particular, the number of authors from outside the Malaysia has increased significantly over time. This shows that *Journal of Rubber Research* is an excellent vehicle for international level of discussion of works among foreign scientists.

**TABLE 4.5: Annual Contribution by Malaysian and Oversea Authors**

| Year | Malaysians | Foreigners | Total |
|---|---|---|---|
| 1996 | 16 | 14 | 30 |
| 1997 | 9 | 18 | 27 |
| 1998 | 12 | 14 | 26 |
| 1999 | 10 | 20 | 30 |
| 2000 | 8 | 27 | 35 |
| 2001 | 9 | 21 | 30 |
| 2002 | 11 | 13 | 24 |
| 2003 | 11 | 16 | 27 |
| 2004 | 9 | 17 | 26 |
| 2005 | 7 | 14 | 21 |
| 2006 | 11 | 11 | 22 |
| 2007 | 9 | 14 | 23 |
| 2008 | 10 | 15 | 25 |
| 2009 | 8 | 22 | 30 |
| 2010 | 11 | 13 | 24 |
| 2011 | 14 | 7 | 21 |
| 2012 | 13 | 9 | 22 |
| 2013 | 16 | 6 | 22 |
| 2014 | 7 | 17 | 24 |
| 2015 | 9 | 16 | 25 |
| Total | 210 | 304 | 514 |
| Percentage (%) | 40.87 | 59.1 | 100.00 |

### 4.3.4 Geographical Distribution Pattern of Authors

The potential of JRR to attract manuscripts from foreign authors is investigated based on the geographical layout of authors. The geographical layout of contributors is shown in Table 4.6. It is found that there are 514 authors who have contributed to 412 articles and the contributors are distributed, over 29 countries of the world. Out of the total 514 authors, the contributing authors came from various countries, with the majority of them from Malaysia, United Kingdom, India, Thailand, Japan, France and China.

**Table 4.6: Geographical Distribution Pattern of Authors**

| | Country | No. of Contributors | Cumulative Contributors | Percentage |
|---|---|---|---|---|
| 1 | Malaysia | 210 | 210 | 40.86 |
| 2 | United Kingdom | 64 | 274 | 12.45 |
| 3 | India | 48 | 322 | 9.34 |
| 4 | Japan | 30 | 352 | 5.83 |
| 5 | France | 29 | 381 | 5.64 |
| 6 | Thailand | 27 | 408 | 5.25 |
| 7 | China | 23 | 431 | 4.47 |
| 8 | United States | 14 | 445 | 2.72 |
| 9 | Sri Lanka | 10 | 455 | 1.95 |
| 10 | Ivory Coast | 10 | 465 | 1.95 |
| 11 | Vietnam | 8 | 473 | 1.56 |
| 12 | Netherlands | 7 | 480 | 1.36 |
| 13 | Brazil | 6 | 486 | 1.17 |
| 14 | Belgium | 5 | 491 | 0.97 |
| 15 | Indonesia | 4 | 495 | 0.77 |
| 16 | Cameroon | 3 | 498 | 0.58 |
| 17 | Australia | 2 | 500 | 0.39 |
| 18 | Singapore | 2 | 502 | 0.39 |
| 19 | Nigeria | 2 | 504 | 0.39 |
| 20 | Yemen | 1 | 505 | 0.19 |
| 21 | Finland | 1 | 506 | 0.19 |
| 22 | Scotland | 1 | 507 | 0.19 |
| 23 | Canada | 1 | 508 | 0.19 |
| 24 | Germany | 1 | 509 | 0.19 |
| 25 | Iran | 1 | 510 | 0.19 |

| | | | | |
|---|---|---|---|---|
| 26 | Pakistan | 1 | 511 | 0.19 |
| 27 | Austria | 1 | 512 | 0.19 |
| 28 | Saudi Arabia | 1 | 513 | 0.19 |
| 29 | Poland | 1 | 514 | 0.19 |

### 4.3.5 Degree of Collaboration

To know the status of collaboration by rubber researchers in *Journal of Rubber Research* during 1996 till 2015, the degree of collaboration between authors is described in Table 4.7. The degree of collaboration among authors who published in JRR was determined using the formula proposed by Subramanyam (1982) as described in Chapter 3.

**Table 4.7: Degree of Collaboration by Year (Subramanyam's Formula)**

| Year | No. of Single Authored Titles | No of Multi-author Titles | Total No. of Articles | Degree of Collaboration |
|---|---|---|---|---|
| 1996 | 2 | 21 | 23 | 0.91 |
| 1997 | 5 | 19 | 24 | 0.79 |
| 1998 | 2 | 21 | 23 | 0.91 |
| 1999 | 5 | 17 | 22 | 0.77 |
| 2000 | 1 | 23 | 24 | 0.96 |
| 2001 | 3 | 19 | 22 | 0.86 |
| 2002 | 4 | 14 | 18 | 0.77 |
| 2003 | 1 | 20 | 21 | 0.95 |
| 2004 | 0 | 20 | 20 | 1 |
| 2005 | 6 | 14 | 20 | 0.7 |
| 2006 | 5 | 14 | 19 | 0.74 |
| 2007 | 5 | 16 | 21 | 0.76 |
| 2008 | 2 | 17 | 19 | 0.89 |
| 2009 | 1 | 18 | 19 | 0.94 |
| 2010 | 5 | 15 | 20 | 0.75 |
| 2011 | 1 | 18 | 19 | 0.95 |
| 2012 | 3 | 17 | 20 | 0.85 |
| 2013 | 2 | 18 | 20 | 0.9 |
| 2014 | 1 | 19 | 20 | 0.95 |
| 2015 | 3 | 15 | 18 | 0.83 |
| TOTAL | 57 | 355 | 412 | 0.86 |

Table 4.7 showed that the degree of collaboration in JRR between 1996 and 2015 varied from 0.70 to 1.00 and seemed to be inconsistent from 1996 to 2002. In 2004, the degree collaboration is the highest (1.00) and indicates that all articles were published by multi-authors, no single author. This result indicated that, like most field in the sciences, collaboration between authors in the field of rubber research is higher and is a common practice.

## 4.4 Acknowledgement Patterns in Journal of Rubber Research articles.

The content of JRR in term of acknowledgements in *Journal of Rubber Research* (JRR) was investigated. Table 4.8 shows that acknowledgements being incorporated in research articles in JRR. In 412 articles, 306 (74.27%) carries formal acknowledgement. 2012 registered the highest number of articles (95%) with acknowledgements, while 2000 registered the lowest number (54.17%).

**Table 4.8: Acknowledgements as contained in JRR**

| Year | Articles Published | Articles Published With Acknowledgements | Percentage of Articles with Acknowledgements |
|---|---|---|---|
| 1996 | 23 | 18 | 78.26 |
| 1997 | 24 | 14 | 58.33 |
| 1998 | 23 | 15 | 65.22 |
| 1999 | 22 | 14 | 63.64 |
| 2000 | 24 | 13 | 54.17 |
| 2001 | 22 | 16 | 72.73 |
| 2002 | 18 | 14 | 77.78 |
| 2003 | 21 | 16 | 76.19 |
| 2004 | 20 | 17 | 85.00 |
| 2005 | 20 | 16 | 80.00 |
| 2006 | 19 | 15 | 78.95 |
| 2007 | 21 | 15 | 71.43 |
| 2008 | 20 | 13 | 65.00 |
| 2009 | 19 | 17 | 89.47 |
| 2010 | 19 | 13 | 68.42 |
| 2011 | 19 | 12 | 63.16 |

| | | | |
|---|---|---|---|
| 2012 | 20 | 19 | 95.00 |
| 2013 | 20 | 18 | 90.00 |
| 2014 | 20 | 17 | 94.44 |
| 2015 | 18 | 14 | 77.78 |
| TOTAL | 412 | 306 | 74.27 |

### 4.4.1 Frequency distribution of acknowledgements

Table 4.9 provides information on count on articles with acknowledgements, acknowledgement count for the related articles and the mean number of acknowledgements per article. 1996 is the year with the most number of acknowledgements per article is 1996, i.e. 45/ 18 = 2.5, while the least number for the year of 2008 and 2014 (1.6 acknowledgement per article) lowest in year 2008 and 2014 (1.6 per item). Overall, 2.0 acknowledgement per article if all the years take into account.

**Table 4.9: Acknowledgement per Article**

| Year | Number of Articles With Acknowledgements | Number of Acknowledgement in Articles | Mean |
|---|---|---|---|
| 1996 | 18 | 45 | 2.5 |
| 1997 | 14 | 25 | 1.8 |
| 1998 | 15 | 34 | 2.3 |
| 1999 | 14 | 34 | 2.4 |
| 2000 | 13 | 26 | 2.0 |
| 2001 | 16 | 34 | 2.1 |
| 2002 | 14 | 25 | 1.8 |
| 2003 | 16 | 32 | 2.0 |
| 2004 | 17 | 31 | 1.8 |
| 2005 | 16 | 29 | 1.8 |
| 2006 | 15 | 35 | 2.3 |
| 2007 | 15 | 28 | 1.9 |
| 2008 | 13 | 21 | 1.6 |
| 2009 | 17 | 26 | 1.5 |
| 2010 | 13 | 28 | 2.2 |
| 2011 | 12 | 26 | 2.2 |
| 2012 | 19 | 33 | 1.7 |
| 2013 | 18 | 42 | 2.3 |
| 2014 | 17 | 28 | 1.6 |
| 2015 | 14 | 26 | 1.9 |
| TOTAL | 306 | 602 | 2.0 |

### 4.4.2 Categorising Acknowledgements

Table 4.10 showed the acknowledgements through categorisation. It is found that the technical category has the most number of acknowledgements (21%), next is the financial support category (20%), further down are moral support (15%), clerical (11%), PIC (10%), and access to facilities (7%). No classification can be done for the remaining 14.6% because of the inadequacy of right information.

**Table 4.10: Category of Acknowledgements**

| Year | Moral support | Financial Support | Access | Clerical Support | Technical Support | PIC | Unclassified | Total |
|---|---|---|---|---|---|---|---|---|
| 1996 | 9 | 7 | 4 | 2 | 10 | 11 | 2 | 45 |
| 1997 | 3 | 6 | 3 | - | 5 | 5 | 3 | 25 |
| 1998 | 5 | 6 | 2 | 7 | 10 | 4 | - | 34 |
| 1999 | 5 | 10 | 3 | 4 | 8 | 4 | 3 | 37 |
| 2000 | 3 | 5 | 3 | 6 | 5 | 4 | 4 | 30 |
| 2001 | 5 | 7 | 2 | 7 | 8 | 5 | 2 | 36 |
| 2002 | 6 | 5 | 1 | 4 | 4 | 5 | 5 | 30 |
| 2003 | 2 | 10 | 3 | 4 | 9 | 4 | 8 | 40 |
| 2004 | 4 | 6 | 3 | 6 | 11 | 1 | 8 | 39 |
| 2005 | 4 | 4 | 3 | 7 | 8 | - | 3 | 29 |
| 2006 | 8 | 6 | 1 | 2 | 10 | 8 | 4 | 39 |
| 2007 | 5 | 2 | 2 | 5 | 5 | 5 | 11 | 35 |
| 2008 | 4 | 6 | 3 | 2 | 4 | 2 | 5 | 26 |
| 2009 | 5 | 5 | 3 | 3 | 7 | 3 | 5 | 31 |
| 2010 | 4 | 7 | 2 | 5 | 9 | 1 | 7 | 35 |
| 2011 | 7 | 3 | 1 | 8 | 5 | 2 | 8 | 34 |
| 2012 | 9 | 12 | 1 | 3 | 5 | 3 | 6 | 39 |
| 2013 | 9 | 11 | 6 | 2 | 12 | 2 | 10 | 52 |
| 2014 | 6 | 12 | 1 | 2 | 7 | - | 3 | 31 |
| 2015 | 2 | 10 | 2 | 4 | 6 | 2 | 5 | 31 |
| Total | 105 | 140 | 49 | 83 | 148 | 71 | 102 | 698 |
| (%) | 15.04 | 20.06 | 7.02 | 11.89 | 21.20 | 10.17 | 14.61 | 100.00 |

## 4.5 Citations Received by *Journal of Rubber Research* (JRR)

The citation analysis is the citation count for a journal, an article, a field, or a country's publications. This is the number of times of which a research paper being cited by other papers (Chiu and Ho, 2005). Over the years, Thomson ISI Web of Science is the database which represents the source where bibliometric data can be obtained, also caters for *Journal Impact Factors* (JIF) (Harzing and Van der Wal, 2008). *Journal of Rubber Research* is a journal being *ISI*-indexed. Web of Science (WoS), which provides indexes to peer reviewed journals, constitutes a large database for keeping track of citations. WoS indexes all the articles published in JRR from 2007 to 2016. The citation information given by WoS was used to determine the total citations received by JRR articles (Table 4.11). There was a total of 176 JRR articles indexed in WoS from 2007 to 2015, which had received 169 citations from various publications between 2008 to 2015 generated by WoS. Articles published in JRR in 2007 received the highest number of citations (40 citations), followed by articles published in 2009 (38), and in 2008 (37 citations). This pattern indicates that older articles published in JRR were being cited more. It also showed that the articles published recently are getting early citations, in some cases within a year.

Based on the study conducted by Bauer and Bakkalbasi (2005) to analyse the citation counts of the *Journal of the American Society for Information Science and Technology* (JASIST), it is concluded the WoS catered more citation counts for 1985 articles.

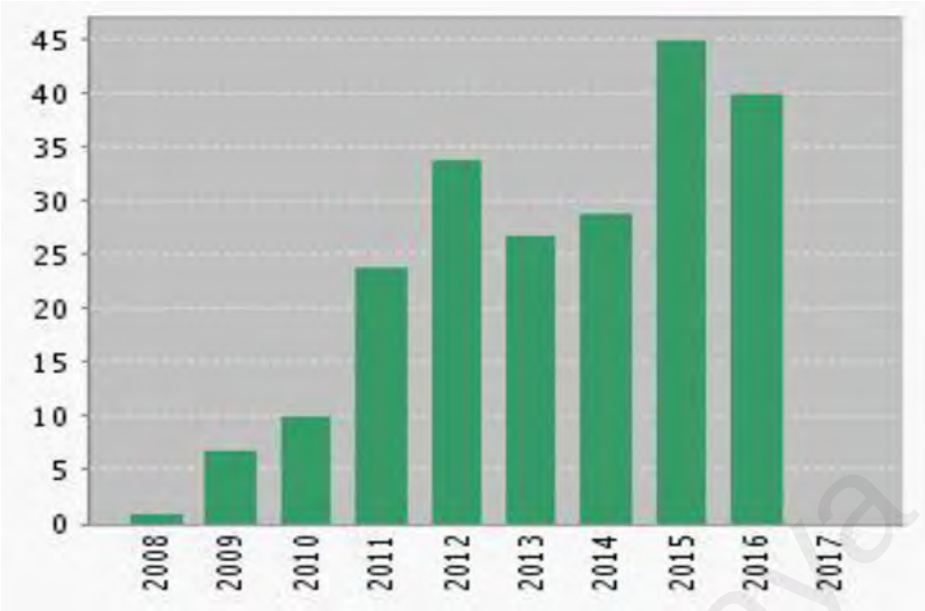


**Figure 4.3: Total citations received by JRR per year**

**Table 4.11: Total Citations received by JRR articles**

| Year of Publication | JRR articles cited | Year and No. Of Times Cited | Citations Total |
|---|---|---|---|
| 2007 | 14 | 2008 (1) 2009 (2) 2010 (4) 2011 (7) 2012 (10) 2013 (5) 2014 (3) 2015 (8) | 40 |
| 2008 | 16 | 2009 (3) 2010 (2) 2011 (7) 2012 (5) 2013 (7) 2014 (7) 2015 (6) | 37 |
| 2009 | 11 | 2009 (1) 2010 (3) 2011 (8) 2012 (11) 2013 (6) 2014(1) 2015 (8) | 38 |
| 2010 | 5 | 2010 (1) 2011 (2) 2013 (2) 2014 (7) 2015 (5) | 17 |
| 2011 | 9 | 2012 (1) 2013 (5) 2014 (1) 2015 (5) | 12 |
| 2012 | 7 | 2012 (1) 2013 (2) 2014 (4) 2015 (7) | 14 |
| 2013 | 8 | 2014 (5) 2015(4) | 9 |
| 2014 | 5 | 2015 (1) | 1 |
| 2015 | 3 | 2015 (1) | 1 |
| | 78 | | 169 |

There was a total of From Table 4.11, it can be observed of 178 publications JRR from 2007 to 2015, 43.8 per cent (78) of the publications are cited more than once, one time or the other. It is clearly seen that JRR articles are catching the attention of both national and international researchers as the study noted that JRR articles are sources of knowledge in scholarly journals, and books or book chapters (Table 4.12).

**Table 4.12: Types of documents citing JRR articles published between 2007 and 2015**

| | Bibliographic Format | Frequency |
|---|---|---|
| **1** | **Journal Articles** | **158** |
| **2** | **Books and Book Chapters** | **11** |
| | **TOTAL** | **169** |

As indicated in Table 4.12, JRR received citations mainly from journal articles (158 times), and books and book chapters (11 times). These citations were to articles published within the years 2007 to 2015 only.

Overall, in WoS it also provide quality citation data which show whom has cited JRR paper, when and where, providing an opportunity to review the impact of that paper. Within this database, journals are ranked in quartiles and it can identifies the impact factor for all journal within a subject category or within the Journal Citation Reports. Journal Citation Reports (JCR) metrics file were used as part of this investigation as indicators of the research significance of JRR.

This result shows that the JRR articles have been recorded 29 times in the first quartile of journals from 2007 to 2015 as confirmed by WoS. In addition to that, JRR articles are selected as many as 16 times in second quartile of journals, 10 times in third quartile of journals, and 11 times in the fourth quartile of journals. The study revealed

that JRR articles are cited from other international rubber research journals (Table 4.13) such as *Journal of Applied Polymer Science (12), Rubber Chemistry and Technology (11), KGK-Kautschuk Gummi Kunststoffe (6)* and *BMC Plant Biology (4).* This demonstrates that JRR articles have influence and impact on the global research community because most of the articles are put under the category as 'high-impact', based on their impact factor ranking.

**Table 4.13: Top journals citing JRR articles published from 2007 to 2015**

| | Journals | No of times | WoS JCR Quartile | Impact Factor |
|---|---|---|---|---|
| 1 | Journal Of Applied Polymer Science | 12 | Q2 | 1.768 |
| 2 | Rubber Chemistry And Technology | 11 | Q3 | 1.024 |
| 3 | KGK-Kautschuk Gummi Kunststoffe | 6 | Q4 | 0.212 |
| 4 | BMC Plant Biology | 4 | Q1 | 3.813 |
| 5 | IEEE Symposium On Business, Engineering And Industrial Applications (Isbeia 2012) | 3 | NA | NA |
| 6 | Polymer Degradation And Stability | 3 | Q1 | 3.163 |
| 7 | Biochemie | 2 | NA | NA |
| 8 | Bioresources | 2 | Q1 | 1.425 |
| 9 | European Review For Medical And Pharmacological Sciences | 2 | Q4 | 1.213 |
| 10 | Fibers and Polymers | 2 | Q2 | 0.881 |
| 11 | Field Crops Research | 2 | Q1 | 2.976 |
| 12 | Industrial Crops And Products | 2 | Q1 | 2.837 |
| 13 | International Journal of Adhesion and Adhesives | 2 | Q2 | 1.773 |
| 14 | Journal of Adhesion | 2 | Q2 | 1.417 |
| 15 | Plant Cell Reports | 2 | Q1 | 3.071 |
| 16 | Plastics Rubber and Composites | 2 | Q3 | 0.583 |
| 17 | PLoS One | 2 | Q1 | 3.234 |

| | | | | |
|---|---|---|---|---|
| 18 | Polymer Testing | 2 | Q1 | 2.240 |
| 19 | Polymers and Polymer Composites | 2 | Q4 | 0.271 |
| 20 | 2009 IEEE 70th Vehicular Technology Conference Fall | 1 | NA | NA |
| 21 | 2013 IEEE Business Engineering and Industrial Applications Colloquium | 1 | NA | NA |
| 22 | Acta Physiologiae Plantarum | 1 | NA | NA |
| 23 | Advances in Polymer Technology | 1 | Q3 | 1.045 |
| 23 | Agronomy for Sustainable Development | 1 | Q1 | 3.992 |
| 24 | Biomacromolecules | 1 | Q1 | 5.750 |
| 25 | BMC Genomic | 1 | Q1 | 3.986 |
| 26 | Catalysis Letters | 1 | Q2 | 2.307 |
| 27 | Cell Proliferation | 1 | Q3 | 3.116 |
| 28 | Colloid and Polymer Science | 1 | Q3 | 1.865 |
| 29 | European Review for Medical and Pharmalogical Sciences | 1 | Q4 | 1.213 |
| 30 | Fibres & Textiles in Eastern Europe | 1 | Q2 | 0.667 |
| 31 | Forest Pathology | 1 | Q2 | 1.373 |
| 32 | Industrial & Engineering Chemistry Research | 1 | Q1 | 2.587 |
| 33 | International Journal of Molecular Sciences | 1 | Q2 | 2.862 |
| 34 | Iranian Polymer Journal | 1 | Q2 | 1.806 |
| 35 | Journal of Adhesion Science and Technology | 1 | Q3 | 0.961 |
| 36 | Journal of Alloys and Compounds | 1 | Q2 | 2.999 |
| 37 | Journal of Chemical Technology and Biotechnology | 1 | Q2 | 2.349 |
| 38 | Journal of Elastomers and Plastics | 1 | Q4 | 0.773 |
| 39 | Journal of Experimental Botany | 1 | Q1 | 5.526 |
| 40 | Journal of Industrial Textiles | 1 | Q1 | 1.349 |
| 41 | Journal of Materials Science | 1 | Q1 | 2.371 |
| 42 | Journal of Nanomaterials | 1 | Q3 | 1.644 |
| 43 | Journal of Plant Physiology | 1 | Q1 | 2.557 |

| | | | | |
|---|---|---|---|---|
| 44 | Journal of Polymer Materials | 1 | Q4 | 0.308 |
| 45 | Journal of Polymer Research | 1 | Q2 | 1.920 |
| 46 | Journal of Polymer Science Part A-Polymer Chemistry | 1 | Q1 | 3.113 |
| 47 | Journal of Polymers and the Environment | 1 | Q2 | 1.671 |
| 48 | Journal of Testing and Evaluation | 1 | Q4 | 0.379 |
| 49 | Kobunshi Ronbunshu | 1 | Q4 | 0.175 |
| 50 | Langmuir | 1 | Q1 | 4.457 |
| 51 | Macromolecular Symposia | 1 | NA | NA |
| 52 | Materials & Design | 1 | Q1 | 3.501 |
| 53 | Materials Chemistry and Physics | 1 | Q2 | 2.259 |
| 54 | Organometallics | 1 | Q1 | 4.126 |
| 55 | Pakistan Journal of Pharmaceutical Sciences | 1 | Q4 | 0.682 |
| 56 | Pesquisa Agropecuaria Brasileira | 1 | Q3 | 0.575 |
| 57 | Physiology and Molecular Biology of Plants | 1 | Q3 | 1.351 |
| 58 | Plant Cell and Environment | 1 | Q1 | 6.960 |
| 59 | Plant Science | 1 | Q1 | 9.338 |
| 60 | Polymer | 1 | Q1 | 3.562 |
| 61 | Polymer Engineering and Science | 1 | Q2 | 1.520 |
| 62 | Polymer-Plastics Technology and Engineering | 1 | Q3 | 1.511 |
| 63 | Polymers for Advanced Technologies | 1 | Q2 | 1.757 |
| 64 | Progress in Polymer Science | 1 | Q1 | 26.932 |
| 65 | Progress in Rubber Plastics and Recycling Technology | 1 | Q4 | 0.452 |
| 66 | Rheologica Acta | 1 | Q1 | 1.869 |
| 67 | Romanian Biotechnology Letters | 1 | Q4 | 0.404 |
| 68 | RSC Advances | 1 | Q1 | 3.840 |
| 69 | Soft Matter | 1 | Q1 | 4.029 |
| 70 | Textile Research Journal | 1 | Q1 | 1.599 |
| 71 | Tree Physiology | 1 | Q1 | 3.655 |

## 4.6 Summary of Chapter Four

This bibliometric study has shed light on the publication practice of the *Journal of Rubber Research* from year 1996 till 2015. In this chapter, the main research questions have been answered, by presenting the results of the data analysis in accordance with the objectives of the study. The study analysed a twenty-year period in the publication process of *Journal of Rubber Research* obtained data from the Rubber Information Online System (http://rios.lgm.gov.my/cms). Data were analysed descriptively and results have it that, the number of articles during the twenty-years (1996-2015) period of publication is four hundred and twelve (412). The average number produced per year is 21 articles, which indicate a consistent balance in the journal's publication productivity.

In term of collaborations, only 57 articles (13.83%) were single authored. Joint authorship by 4 and more authors have the highest frequency of 151 articles (36.65%) followed by 3 authors with 117 articles (28.40%). Thus, multi-authored articles far out-numbered single-authored articles, comprising 86.17 percent of the total articles studied. This suggests that authors in the rubber research have a custom of collaborating with their peers. The degree of collaboration in JRR from 1996 to 2015 is (1.0), ranging from 0.73 to 1.00. This indicates that collaboration between authors in the field of rubber research is higher and is a common practice. The study also observes that 40.87 percent (210) authors are affiliated to Malaysia, while 59.1 percent (304) are from foreign countries. Furthermore, according to the results of authors affiliated, out of the total 514 authors, the contributing authors came from various countries, with the majority of them from Malaysia, United Kingdom, India, Thailand, Japan, France and China.

Furthering the analysis on the acknowledgements included in research articles under Journal of Rubber Research, the number of items 306 (74.27%) contains formal

acknowledgements. In general, the average number of acknowledgements per item is 2.0, with technical support being the most commonly acknowledged.

Since JRR is included in the Web of Science (WoS), which provides citation information, through Web of Science (http://www.web of knowledge.com) it was observed from 2007 to 2015, a total of 178 articles under JRR, 43.8 percent (78) are cited at one time or the other. The findings demonstrate that JRR articles are drawing the attention of national and international researchers. The study clearly shows that JRR articles are sources of knowledge in scholarly journals (158 times) and books or book chapters (11 times). The top journals citing JRR articles are: *Journal of Applied Polymer Science* (12*), Rubber Chemistry and Technology (11), KGK-Kautschuk Gummi Kunststoffe (6)* and *BMC Plant Biology* (4).

# CHAPTER 5

# DISCUSSIONS AND CONCLUSION

## 5.1 Introduction

After analysing the data collected from JRR in previous chapter, this chapter discusses the research findings in this study. The main objective of the study is to examine the publication productivity pattern of articles published in the JRR between a 20-year period (1996-2015). The study was achieved by practising the bibliometric method for the publication productivity, co-authorship pattern, degree of collaboration, types of collaborations, distribution of contributing countries, distribution of acknowledgement in articles, type of acknowledgement, and the total number of citations received by JRR.

Hence, as regard to the goal of the study, this section discusses the results of the study, and subsequently conclude with recommendations for future bibliometric studies.

## 5.2 Findings and Discussions

### 5.2.1 Article productivity of *Journal of Rubber Research* from 1996-2015

Publishing is important to scientists for disseminating research results to the scientific community and discoveries to the masses in the general. In this digital era with a massive information overflowing on the Internet, authors encounter the daunting tasks to select journals and for editors to choose articles. Since JRR is the main publication in the investigation solely published by rubber organisation, it is the main source of publication used by MRB researchers to publish their research findings. First, the study is aims to find the publication productivity of JRR between the period of twenty years (1996-2015). As regard to this, the study observed that 412 articles were produced, with an average of 21 articles per year. Tiew (1998) conducted a study on

JnNR from year 1988 till 1997 and observed that a total of 258 articles were produced during a ten year period, with an average of 24 articles per year. Comparing Tiew's result (average of 24 articles per year) with the findings of this present study (average 21 articles per year), it shows that JRR have recorded 3 percent decrease in article productivity.

### 5.2.2 Co-Authorship Pattern

The co-authorship pattern in this study refers to the number of authors involved in publishing the works retrieved. Co-authorship in publications is widely considered as a reliable proxy for scientific collaboration. It is part of the objective of the study to find out about the co-authorship practice of authors. It was revealed that co-authorship is the rule rather than the exception. Besides that, this study was sought to understand scientific collaboration in rubber research by investigating co-authorship patterns. Furthermore, analysing co-authorship is one way to assess the breadth and depth of contribution from different geographical location, and to provide a window on patterns of collaboration.

Authorship pattern has also been studied by Tiew before, in JnNR (1987-1996) and found that, two-authored articles comprised the highest percentage (35.3%) of the total 258 articles. Single authored articles constituted 27.9 percent of the total contribution. Three authored articles accounted for 21.7 percent, four-authored articles 10.5 percent and the rest i.e.; 4.6 percent were by five or more authors. Thus, multi-authored articles far out-numbered single-authored articles comprising 72.1 percent of the total articles studied. The study reveals that, a total 412 articles produced during the period under study, only 57 articles (13.83%) were single authored. Joint authorship by 4 and more authors have the highest frequency of 151 articles (36.65%) followed by 3 authors with 117 articles (28.40%). Thus, the quantity of articles published under

multi authored surpasses the quantity of published under single author, comprising 86.17 percent of the total articles studied. In the sample studied, the one and only research article with the most number of authors is '*Occurrence and characterisation of mycoflora in soil of different health conditions associated with white root rot disease in Malaysian rubber plantation'* co-authored by eleven researchers mainly from Malaysia and only one from Poland. This suggests that authors in the rubber field have a custom of collaborating with their peers (Tiew, 1998; Tiew & Kiran, 2000), the reason as explained by (Sombatsompop et al, 2009), that in rubber research, problems are commonly interdisciplinary in nature and thus it is especially crucial to foster collaborative behaviour. Wiles et al, (2010) supporting this idea and noted that as companies have merged into multi-national corporations in order to compete, it is possible that there is greater collaboration within or across research institutions. On the average, more than 90 percent of all the articles were collaboratively produced.

### 5.2.3 Degree of Collaboration

Scientific research is evolving into a partnering venture. The type and degree of teaming up differ from one field to another, and it depends on the contributing elements underlying the fundamentals of the research problem, the research environment, and demography. Preliminary investigations have demonstrated a significant correlation between collaboration and research productivity, and between collaboration and financial backing for research. The magnitude of collaboration cannot be easily worked out by traditional methods of survey and observations. Bibliometric methods are frequently used because it provides a handy and non-reactive tool for studying collaboration in research. In this study, the formula suggested by Subramanyam (1982) is used to measure the ratio of multi-authored papers published to the total number of papers published in JRR. The value degree of collaboration in Subramanyam's

definition indicates clear concept of the extent of collaboration in a certain discipline. This present study showed that the degree of collaboration is higher in rubber research. Finding the rate of collaboration of authors is an important objective of this study. This was achieved by analysing the number of single and multi-authored articles per year. The result shows that the degree of collaboration in *JRR* between years 1996 and 2015 varied from 0.7 to 1.00. However, compared to the previous research by Kanesan Solomalai (1983), it showed a significant differences related with the degree of collaboration in rubber physics literature. The result from his study recorded the degree of collaboration among rubber physics from 1940 to 1981 are low, ranged from 0.08 to 0.54. From both studies, research results indicate that there has been increase in multi-authored papers because of the availability of financial support, nature of the research problem and the research environment (Solomalai, 1983)

### 5.2.4 The Collaboration Patterns and Active Collaborating Countries

Collaboration is a basic and universal aspect in scientific research. It takes up a variety of modes from pooling of thought among researchers to corporate cooperation and research teaming up. Collaboration emerges at different hierarchies within the research structure: *micro-level* (individuals, research groups), *meso-level* (faculties, institutions, departments), and *macro-level* (institutional sectors, specifically collaborative agreements between university and industry, or regions).

The findings of the present research showed type of collaboration (domestic and international) of the contributing authors. In this present study, all the publications authored by two or more persons are treated as collaborative papers. Thus, it is also part of the objective of this present study to determine the internationality of JRR through the number of contributing foreign authors and the extent of collaboration with authors from different regions of the world. In all, MRB authors collaborated with their foreign

counterpart 65 times, while foreign authors collaborated with each other 33 times. In total, 98 articles were either authored or co-authored by foreign contributors. Based on internationally collaborative papers, Malaysia ranked first with 210 contributors (40.86%), followed by 64 contributors from United Kingdom (12.45%) and 48 contributors from India (9.34%).

A bibliometric study done by MASTICS (2016) also revealed that in term of collaboration with foreign researchers, Malaysian researchers worked more with those from the United Kingdom. Zainab, Anyi and Anuar (2009) analysed the *Malaysian Journal of Computer Science* had similarly found that top articles were contributed by Malaysians who collaborated with authors from United Kingdom.

### 5.2.5 Geographical distribution of Authors

Analysis and explaining the geographical distribution of authors gives important information regarding the visibility of the journal in the different research segments and institutions both Malaysian and abroad. JRR has successfully completed 91 years of publication. It has got world-wide recognition and is steadily growing to be a very promising journal in the area of rubber research by attracting scholarly articles from around the world. This section will answer research question (e): To highlight any other findings and contributions towards the internationalisation of JRR. Illustrated in Table 4.5 based on country is the number of contributors from Malaysia and oversea countries. All in all, 40.87 percent (210) of the authors are affiliated to Malaysia, on the other hand, 59.1 percent (304) are from foreign countries. In particular, the number of authors from outside the Malaysia has increased significantly over time.

A total of 304 foreign authors (59.1%) were contributed papers in JRR. Most active collaborating country was the United Kingdom with 64 (12.45 %) authors, followed closely by the India (9.34%), Japan (5.83%), France (5.64%), Thailand

(5.25%), and China (4.47%). However, in terms of contributors among rubber producing countries, other active researchers were from Sri Lanka, Ivory Coast, Vietnam, Indonesia, and Cameroon which equally are among 10 to 2 persons (1.95% and 0.58%). The results from this present study indicates the internationalisation character of JRR, which publishes the bulk of foreign articles based on the percentage of foreign (59.1%) *vs* local contributions (40.87%). This pattern of geographical distribution of authors is similarly found by Zainab (2008) that the majority contributors to the *Bulletin of the Malaysian Mathematical Science Society* were 79 percent from foreign countries and 21 percent from Malaysian.

However, this geographical distribution of authors is differently found by Ramesh and Nagaraju (2000) with regard to their study on single journal entitled *International Journal of Tropical Agriculture* (IJTA). They found that Indian authors are the main contributors (87%), while only 13 percent of authors are foreign authors which are from Nigerian and Bangladesh. Koyle and Sen (2014) also recorded 69.46 percent contributions from Indian authors, while 29.19 percent by foreign authors contributed in *ETE Journal of Research.*

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### 5.2.6 Citation Received by JRR

Most authors of scientific publications adopt the scholarly habit of acknowledging sources by quoting references. The use made of a paper and the influence exerted by it on later work is in some way reflected in the number of citations it receives: the more important a particular paper is for later development, the more citations it generally will obtain. Citing is an establish way for the authors to declare their sources of information and politely recognise someone's intellectual property (Sanni, 2011). JRR is the first rubber journal in the country and it's the medium

frequently employed by rubber researchers to disseminate their ideas and new knowledge.

In essence, it is essential to find the contribution and relevancy of JRR to the wider community. If articles published were been used and cited by other journals in the field, this citation would demonstrate the importance of the journal. The total number of citations received by JRR from 2007 till 2015 was obtained in Web of Science (WoS). WoS is interdisciplinary database and covers all scientific areas, but it only covers what it considers to 'best' journals. Like all databases, the WoS does not include all articles published, but its selection of journals is highly respected and thus useful for citation analysis.

The citations information given by WoS was used to determine the total citations received by JRR articles. Thus, the results of the findings from WoS showed that 43.8 percent of all the articles published between the years 2007 to 2015 have been cited one time or the other, that the most of the documents citing JRR articles are journal articles (158 times), followed by books and book chapters (11 times). The top four journals citing JRR articles are: *Journal of Applied Polymer Science (12), Rubber Chemistry and Technology (11), KGK-Kautschuk Gummi Kunststoffe (6)* and *BMC Plant Biology (4).* Findings further showed that all the top journals which are citing JRR recorded highest Impact Factor (IF) for year 2014: *Journal of Applied Polymer Science* (1.768), *Rubber Chemistry and Technology* (1.024) and *BMC Plant Biology* (3.813) compared with JRR which it shows that the IF was low (0.23 in 2014). This may indicate that JRR is well received by other international journals especially among the high impact journal. Hence, the result of this study implies that JRR is making contribution to the field of rubber research, and it is expected to grow.

### 5.2.7 Acknowledgement Patterns in Journal of Rubber Research articles.

The practice of acknowledgement in scholarly communication is widespread and growing. Acknowledgements define a variety of cognitive and social relationships between researchers within and across disciplines, and could thus be used to map networks of influence. It allows researchers to reflect their gratitude for any kind of help received from others during the writing of articles. Besides that, acknowledgments are one of many conventions by which researchers publicly bestow recognition towards individuals, organizations and institutions that contributed in some way to the work that led to publication. The importance of acknowledgements is highlighted by results of surveys showing the frequency with which they occur in the papers. Acknowledgement patterns in JRR research articles have been studied earlier by Tiew in 2002. Analyses the acknowledgements included in the research articles and short communications published in JnNR (1986-1997) in respect of types, frequency of occurrence, individuals acknowledged, etc. Results indicate that 74 percent items contain acknowledgements; an average acknowledgement per item is 2.2; the most common type of acknowledgments relates to technical support. Peer interactive communication accounts for 44 percent of the total acknowledgements. The result of the study substantiates the earlier findings that a small number of individuals are highly acknowledged and the rest are acknowledged infrequently. Moving forward by analysing the acknowledgements included in research articles published in JRR, the number of items 306 (74.27%) contain formal acknowledgement. On an average, acknowledgement per item is 2.0 and the most common type of acknowledgements relates to technical support.

With this, it can be concluded that there is no obvious difference between investigation being conducted by Tiew before this, with my investigation (in this study). From 1986, until recently, it is evident that writers used to include acknowledgement in

each article being published in JRR. The findings based on both studies lead to the inference that the practice of acknowledgement in rubber research communications are found to be quite common, considering that more than 70% of the articles with acknowledgements being included.

Nimale, Khaparde and Alhamdi (2015) also analyse the acknowledgements appears in the research articles of *International Journal of Information Management* and found that only 123 articles out of 538 (22.86%) articles contained acknowledgements. It showed the practice of acknowledgements in IJIM is not as common compared with the JRR.

## 5.3 Contribution of the Study

This present study is considered as a continuity to the earlier investigation concerning JRR that is conducted by Tiew and Kiran. The approach of the bibliometric method is selected as an quantitative evaluation for comparing results of investigation with those investigation before, in particular, from research output which is considered crucial to map out the growth of JRR publication. Besides, as an additional study to assess the extent the impact of the articles published by JRR, which is commonly measured by the number of times the article gets cited in other scientific publications. Relatively speaking, the results of investigation confirm that the influential role of JRR and further help the scientific community in expanding the investigation of rubber.

Further than that, the result of the investigation helps me as a librarian to identify active research areas and journals relevant to MRB researchers and it is useful when producing reports for planning rubber collection policies and deciding on journal subscriptions and cancellations. Planning rubber collection policies will helps librarian in developing the library collection and information sharing by re-organising the

collection on hand with the relevant materials and to identify the most influential journal in the field of rubber research.

Nevertheless, the findings of the study will be useful to the research directors, administrators and researchers in collaborating with other institutions, based on the investigation findings that identify the key contributing countries, institutions and authors as well as their acknowledgement notes, which have information concerning the research fund.

## 5.4 Limitations of the Study

This study inevitably has its limitations, some resulting from the research design and others such as from the bibliometric techniques that were employed.

1. Selection of Thomson Reuters Web of Science (WoS)

Chief sources of data are bibliographies and bibliographic databases. The databases of the Thomson Reuters, especially WoS have become the most generally accepted basic source for bibliometric analyses. This is because of its unique features that meet basic requirements for bibliometric analysis. Even though WoS is more suitable for bibliometric studies due to its unique features compared to other bibliographic databases, however there were several limitations of the WoS databases. According to Hazmir (2008), among others the limitations of WoS are:

a) Although the WoS databases are quite large in terms of indexed scientific journals, its collective content of scientific research activity and publication output is not necessarily a good reflection of all worldwide scientific publication and research activity especially in the humanities, social sciences and law

b) WoS databases are biased in favour of English-language journals. Non-English journals are not as comprehensively indexed and thus articles in the Indonesian or Thailand language will not be reflected in these databases.

## 5.5 Recommendations of Future Research

a) The study suggests that further research tend to consider on examining the content of article published in JRR by analysing the abstract, length of the articles, and counting the references. In addition, the productivity of authors should be examined.

b) The study suggest that future research objectives should be looking at the proportion of the papers devoted to subjects of more local interest against that of international or regional appeal.

c) The study also suggests that future bibliometric research should check the other bibliographic database such as Scopus and Publish or Perish to perform the number of citations received by JRR.

## 5.4 Conclusion

The bibliometric studies on JRR have highlighted the following:

a) JRR has proven to be an important channel for communicating ideas and knowledge amongst rubber researchers. Over the years, including the 20-year span under study, JRR has managed to sustain its publication without failed, even though there is no fixed rule as to the number of articles JRR will publish in a year. Original articles are the main type of papers for this journal, and papers by authors from Malaysia make up the largest proportion. It also concluded that the publication is open for all subjects of rubber sciences. Further with the high degree of collaboration in rubber research output, it could be attributed that now-a-days the research activities have got the familiarity of

collaborative endeavour, availability of funds and infrastructural facilities in the institutions.

b) Since 2007, JRR was indexed and covered in WoS. Citation analysis is used in this study to measure the overall impact of JRR in WoS and to identify those specific journals that are citing articles published in JRR. This indicates that JRR are visible through international citation indexed, therefore easily accessible for reference. With this, it has increased the chances of articles published in JRR to be used and cited. Even though JRR is a Malaysian journal, publishing both Malaysian and foreigner papers, it is encouraging to discover that the articles published by JRR are being cited. This is clearly indicated by the current study, using citation data provided by WoS. Articles in JRR are being cited by other articles (158 times) in a variety of journals and books internationally. JRR is making contribution to rubber literature as reflected by the citations it receives in each of the 9 years under study. As a result of this visibility, their articles began to be assessable, picked, and used by global rubber researchers, which eventually lead to citation.

c) Analyses the acknowledgements included in the JRR articles using typology developed by Cronin-McKenzie in this study indicate that the practice of acknowledgement in JRR is widespread and growing. Even though, the Editor Committee of JRR doesn't describes how to merit the acknowledgement, but it encourages appropriate acknowledgements will be included in the articles. In any case, the contributors are freely to include their direct technical assistance, acquisition of funding, writing assistance, or general supervision from their research group. It has been proven in this study, the analysis on the acknowledgements which are included in the JRR is 74.27% (the number of item 306 from 412 total articles contains formal acknowledgements).

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