CHAPTER TWO
LITERATURE REVIEW

2.1. Introduction

The research process is imperative for the development of society and research results are valuable for the benefit of general public. Therefore, a central place is given to research in any development plan initiated in developed countries. This has resulted in scientific, social, political, economic and cultural development of the people. Research is carried out for development of knowledge, improvement of existing knowledge, to provide solutions to specific problems, and to improve processes and practices. Since research findings have significance and value for society, research has attained an important place in all fields of knowledge. In the field of horticulture, research has played a crucial role in the creation and improvement of knowledge.

Literature produced by horticultural researchers is important for future development of this field and also agricultural science. It should be analysed to observe prevailing trends but analysis cannot be done unless the literature is properly documented. Bibliographical control and analysis of research literature are time consuming and require concerted efforts on the part of researchers.

Literature search is an essential connection in the process of research. It helps to know what is done by the other researchers in any specific subject. No matter what the subject is, literature search aims at the following functions:

- To know the general understanding on a specific subject and to grasp the essence of the work done by others;
To know that areas are not touched by the early researchers;

- Literature study reduces duplication of research and gives an orientation to the general problems. It narrows the scope, so that greater depth can be achieved;

- Literature study gives insight into the framework of the subjects and suggests the most suitable methods to define and attack a given research problem; and

- It helps to know about methods and procedures that were used successfully by others who have handled similar problems elsewhere.

### 2.2. Literature Review

Sen³ has reported about INSDOC’s (Indian National Scientific Documentation Centre) contribution to bibliometrics. He described about the objectives, facilities, services, research activities, and publications of National Centre on Bibliometrics. The modest beginning of bibliometrics research that INSDOC witnessed in late 1950’s continued towards maturity with the progress of time till late 1980’s.

Parameswaran and Smith⁴ conducted a study on bibliometric analysis of Library and Information Science Abstracts (LISA). In this study, the analysis of the contributions of LISA during the study period (1994-1998) containing almost 60 issues, showed the vital role performed by LISA in the dissemination of information in the subject field of LISA. A drawback found in this abstracting service was that the representation of contributions from the third world countries was meager. Maximum numbers of articles were found to be published in communication and information technology. Majority of the contributions in library and information science were due to single authors. The authors who have published maximum number of articles have been identified. The important foreign and Indian journal having maximum number of citations also have been identified.
The study of a practical line in bibliometrics has been conducted by Meadows. The main purpose of this article is to describe Maurice Line’s continuing interest in bibliometrics and its possible application in library problems since the 1970s. He has covered two major points. One is the concept of obsolescence and how it applies in practice. The other is citation studies of the social sciences. He has emphasized on the limitations that need to be taken into account when trying to apply bibliometrics ideas in practical contexts.

Singh et. al. conducted the bibliometric study of literature on digital libraries. This study provides a comprehensive overview of authorship in the library and information science community. In this paper the authorship patterns, authors’ productivity and prominent contributors, language-wise and year-wise distribution of articles, country-wise distribution of journals, core journals in the subject area, and indexing term frequency have been studied by considering over 1,000 articles from the period 1998-2004 from LISA plus. This study has looked at patterns of authorship in articles published in LISA Plus over a seven-year period. Single authors were responsible for the most of articles published. The main conclusions drawn from this study were that the expected values and observed values in author’s productivity do not follow Lotka’s law and distribution of articles in different journals approximately follows Bradford’s law.

Yeoh and Kaur conducted a studied on subject support in collection development using the bibliometrics tool. The main purpose of this study was to examine the publication output of research in higher education. This study explained a better understanding of the scientific productivity of contributing scholars, specifically in the field of higher education.
Gumpenberger et. al.\textsuperscript{8} conducted the study on the bibliometric practices and activities at the University of Vienna. The purpose of this study is to describe bibliometrics as an emergent field for academic libraries.

Bornman\textsuperscript{9} has done a literature survey on societal impact of research and how can it be assessed. He concluded that since the 1990s, the scope of research evaluations has become broader as the societal products (outputs), societal use (societal references), and societal benefits (changes in society) of research come into scope. He introduced a series of different names which refer to the societal impact of research for example societal benefits, societal quality, usefulness, public values, knowledge transfer, and societal relevance. The main purpose for this review is to serve as a basis for the development of strong and consistent methods of societal impact measurement.

\textbf{2.2.1. Bibliometric Study of Doctoral Dissertations}

Dorban & Vandevenne\textsuperscript{10} studied six doctoral dissertations in economics. They evaluated the ratio ‘number of titles/authors’, the journal/monograph proportion, languages allocation, study of obsolescence. In the bibliography, 95 percent of books and articles are less than 30 years old. In the citations, articles and 95 percent of books are less than 20 years old.

Bandyopadhyay\textsuperscript{11} has made the analysis of 27 doctoral dissertations in mathematics submitted to the Burdwan University as his Ph D work during 1981-1990 and also of the references in the published articles cited in these dissertations. He reported the bibliographic forms of literature used, rank list of periodicals in pure mathematics and statistics, and normalized ranking of periodicals with corrected citation number according to Sengupta’s formula and a correlation study between two lists found by the study.
Biradar & Premalatha\textsuperscript{12} identified the forms, authorship attempts, language wise periodicals & periodical articles, obsolescence of literature and the core journals on the data from 14 master dissertations in psychiatric (Alcoholism) submitted to the Department of Psychiatry, National Institute of Mental Health and Neuro Sciences (NMHANS), and Bangalore during 1974-1995. Results indicated that major forms of reading material in periodical articles (73.222\%). Predominant journals language (97.619\%) and language of the journal articles (99.310\%) were in English. Literature published during the last 20 years contributes almost 64 percent of the total literature.

Buttlar\textsuperscript{13} used citation analysis to analyse sixty-one library science and information science dissertations in United States of America and found that about 80 percent of citations were to single authors, and male authors are cited more frequently than female. The major subject area covered by these dissertations was public services.

Mahapatra & sahoo\textsuperscript{14} analysed to find out the trends and areas of research, growth pattern and productivity of universities along with broad and narrow subject areas using research programmes at the Ph D level in Library and Information Science carried out in India during the seven years (1997-2003). It identified that the highest of theses i.e. thirty seven (37) has been produced in the year 2003, the lowest being in the year 2000. In broad subject area the highest number of Ph D works have been done followed by “Bibliometric and Citation Analysis” and in narrow subject areas, researchers are more interested to take up research works on “Library Resources and Services.”

Ucak & AI\textsuperscript{15} expressed the differences and similarities of inter-disciplinary scholarly communications through the citation analysis of theses. For this purpose, a total of 29,289 citations from 391 theses between years 1968-2007 were investigated using citation analysis. Samples were chosen according to layer-sampling techniques from 16
disciplines of four basic subject areas (social sciences, pure science, engineering, and arts and humanities). It has been found out that the characteristics of citations of the theses differ among academic disciplines. The study finds that literature obsolescence, language of resources, journal or monograph use, number of citations and authors are related to the disciplines and vary according to the subject areas.

Dixit & Katare\textsuperscript{16} analysed a bibliometric analysis on the publication productivity of the scientists of Central Institute for Cotton Research (CICR) using 204 papers published during 2002-2006. The highest number of publications was made in the year 2006-2007 with 47 publications. The multi-authorship trend was definitely indicative towards collaboration within authors. Most preferred subject for publication of the scientists of CICR was plant genetics & breeding (76) as it has the maximum number of publications (37.25\%). CICR scientists prefer publishing their papers in Indian journals compared to foreign journals.

Shukla, Goswami & Sharma\textsuperscript{17} analysed a bibliometric analysis of 50 botany doctoral dissertations of Vikram University Ujjain, Madhyapradesh with the year ranging from 1991-2006. Factors considered for the analysis were illustrations, bibliographical form and ranking of journals, along with the analysis of authorship patterns of total 9254 citations.

Nandi & Bandyopadhyay\textsuperscript{18} evaluated seventy three doctoral dissertations submitted in the Mathematics Department of the University of Burdwan during 1960-2000 and 269 articles produced based on them have been analysed for finding the trend of research, article productivity, choice of journals, authorship pattern and most prolific authors with their credit and impact.
Mishra, Gawde & Singh Solanki\textsuperscript{19} studied the literature cited in the 55 Ph D theses in English submitted Vikram University, Ujjain during 1975 to 2007 to know the citation pattern of research scholars of English using bibliometric techniques. The result indicated that the highest number of thesis is submitted in the year 1991, 1996 and 2002 i.e. 5 Ph D theses and the lowest is so many year i.e. 1 Ph D thesis; books are the most preferred of documents by research scholars in English 80.47% citation and highest used single author 3638 citations (83.70%) and lowest more than three authorship patterns used 103 citations (2.37%).

\textbf{2.2.2. Bibliometric Study of Research Journals}

Sarala\textsuperscript{20} presented the results of bibliometric study of papers published from 1989-1994 in the Journal of Tropical Agriculture. Type of contributions, institution and country of origin and authorship pattern were analysed apart from citation analysis, average number of citations per article and type of documents cited. A rank list of the 30 most commonly cited periodicals is given. It was noted that Indian journals occupied 8 of the top 10 positions in the ranked list.

Sen & Ngah\textsuperscript{21} examined the availability of top ranking scientific periodicals in the University of Malaya Library. The study was based on journal titles listed in the subject category listing of the Journal Citation Report (JCR), 1994 which covered 16 subject fields. They showed that of the first titles listed under each category 72 percent are available in plant sciences and mathematics, 60-70 percent are available in geosciences, ecology and biochemistry and molecular biology, 50-59 percent are available in zoology, applied physics, physics, applied mathematics, genetics and heredity, physical chemistry and chemistry. The availability in other science fields such as analytical chemistry, cell biology and biology is 46 percent.
Dutta & Sen\textsuperscript{22} studied 427 citations appended to 30 articles appeared in January to March 2000 issues of the Indian Journal of Pure and Applied Mathematics. On average there were 14 citations per article and 1.46 authors per citations. The authorship pattern showed that single-authored citations amount to 51.40 percent of total citations.

In the field of agriculture, a bibliometric study was carried out by Ramesh and Nagaraju\textsuperscript{23} on International Journal of Tropical Agriculture (IJTA). They analysed the journal based on 464 papers published in ten volumes from 1991 to 2010. The results indicated that the number of articles published per year fluctuated and was inconsistent from a low of 35 articles in 1998 to as high as 64 in 2000; joint authorship was the norm (89.6\%) and only 10.3\% were single-authored; Indian authors form the majority of contributors (87\%) while the rest (13\%) were from foreign authors with the highest contributions from Nigeria (4.1\%) and Bangladesh (3\%).

Hazarika, Goswami & Das\textsuperscript{24} studied a bibliometric analysis of ‘Indian Forester’ for 1991-2000 considering different parameters of the journal viz. year wise distribution of papers, distribution of papers among different types of organization, institute wise distribution among the ICFRE (Indian Council of Forestry Research & Education) institutes, state wise distribution of papers in Indian territory and the foreign contributions, authorship pattern and number of citations were shown with relevant data analysis. The results indicated that the number of articles published ranged from a low of 114 in 1992 to a high of 156 in 1996. The main contributors were affiliated to research institutes (51.3\%) especially from the Indian Council of Forestry Research and Education followed by the Indian state forest departments (26.8\%).

Nalini\textsuperscript{25} conducted a study on occupational health related publications in India. He concluded that the number of publications was few during the year 2000. The studies on
occupational health are mostly interdisciplinary and conducted as a team work of 2-3 authors and most of the publication contained 5 pages which were concluded by 2 to 73 references. 68 percent of them having been referred to journals and 11.63 percent of the journals were Indian. The major contribution of publication was from studies related to respiratory problems. Majority of the studies was published Indian Journal of Occupational and Environmental Medicine was found to be the most preferred journal. Literature from foreign journals is cited more. Publications with the age more than 30 years are cited rarely. These studies were mostly contributed both by academic institutions and the research institutes, the former’s share being higher than that of latter.

Kherde\(^{26}\) conducted a study on core journals in the field of library and information science during the period 1996 and 2001. Result of this study showed that Annals of Library Science and Documentation are the most popular Indian journal amongst the researchers whereas college and research libraries was the most cited foreign journal. It was evident that the journals and books jointly contribute to the highest number of citations, the share of which was 73.24 %. It was therefore concluded that researchers were depended largely on two sources of information for their study one was journal and another was books.

Dixit and Katare\(^{27}\) investigated the collaborative research in the field of cotton science based on the ten year (1996-2005) collected from the Journal of the Indian Society for Cotton Improvement (ISCI). Readings showed that the number of multi-authored papers (91.04%) surpassed the single authored papers (8.95%). The degree of collaboration in the field of cotton science is 0.91.

Kanungo\(^{28}\) analysed the citation of the citations appended in the articles covered in volume numbers 59-63 of Journal of Asian Studies to determine the information use
pattern of the social scientists. The study has covered 108 articles with total of 9111 citations contributed by 114 authors. The results indicated that books are highly cited documents. The less number of electronic citations suggested that print literature is still the most preferred source of information.

Keshava et. al.\textsuperscript{29} conducted a study on papers in sociology journals during 1999-2003. It was found that a consistent trend towards increase in collaborative research in sociology. Collaborative research has gained importance due to such factors as the emergence of interdisciplinary subjects, mission-oriented and specialized research activities. As a consequence studies of collaborative trends of authorship in a given discipline have also been gaining importance in recent years. The study showed that the highest numbers of papers were published in 2001 and 2003. The number of single author papers was higher as 84 percent out of a total of 475. The value of group co-efficient ($g_p$) was only 0.16. The degree of collaboration among the co-authors was minimum (0.02) in articles written by five authors and maximum (0.12) in two-author papers.

Panda, Mohanty & Sahoo\textsuperscript{30} studied bibliometric analysis of all the contributions (205 articles) included in 10 volumes (volume 45-54) of IASLIC Bulletin published during 2000-2009. The average number of articles published per volume is 20.5; average number of references per article is 10.41; the percentage of multi-authored papers is 51.71 and that of single authored papers is 48.29. All the articles have been categorized into 32 domains and the subject field ‘bibliometrics’ has topped the list with 13.17 percent of publications, followed by ‘internet’ and ‘web resources’ with 8.29 percent. The analyses also revealed that majority of the contributors (19.4\%) are from the state of West Bengal whereas maximum number of contributors (13) is from Aligarh Muslim University, followed by Jadavpur University (11).
Tandon et al\textsuperscript{31}. focused on the trends in publication, authorship pattern, availability, and accessibility of articles during 2008–2010 from the Indian Agricultural Research Institute (IARI), a constituent of the National Agricultural Research System in India. The data reveal that during the period of study, researchers from IARI produced 1,833 publications, most of which were jointly authored, and that the most preferred journal for publication by researchers is the Indian Journal of Agricultural Sciences, which is now an Open Access journal. While publications from IARI are available to subscribers of the Consortium for e-Resources in Agriculture (CeRA), public availability to IARI publications is very meager. Hence, in order to make their research output more accessible and available to a wider audience, IARI researchers should deposit their work in IARI’s Open Access repository Eprints@IARI. However, making such a deposit requires an Open Access policy, which IARI is yet to adopt.

2.2.3. Bibliometric Laws

2.2.3.1. Lotka’s Law

Radhakrishnan & Kerdizen\textsuperscript{32} checked that the law of Lotka did not apply appropriately to the data about publications in informatics, observing that it was nearest to a law $x^{-3}$. These authors assumed that when a work had many authors, to each one of them belonged the complete work (normal count). To prove this hypothesis, it was examined sample from this field, registering only one author for each work, and without applying any statistics test, concluded that the data adjusted themselves to the law of Lotka.

Gupta\textsuperscript{33} created four different cases in the biochemical field from Nigeria, one with all the authors, another with only the first ones, with the non collaborators and one fourth only with the co-authors, it was checked that the Lotka’s law could be applied at the four
cases, but with distinct values at the exponent. To check the adjustment it was used the test Kolmogorov-Smirnov, to a significant level of 0.01.

Larsen and Ins\textsuperscript{34} studied the Lotka’s Law, co-authorship and interdisciplinary publishing. This study depicts that the Lotka’s Law is valid if all the preconditions are fulfill. They also concluded that the change from single-authored to multi-authored research has not change the fundamental production principles of cumulative advantage and the Matthew principle.

Sevukan & Sharma\textsuperscript{35} presented a detailed analysis of research performance of biotechnology faculties in Central Universities of India from 1997-2006. The results indicated that the growth of literature in biotechnology has steadily increased from 15 articles in 1997 to 43 articles in 2006; two-authored publications predominate amongst the pattern of authorship; applicability of Lotka’s law is validated from the values n=2.12, C=0.669, and D=0.027 obtained using least square method.

Sobrino, Caldes & Guerrero\textsuperscript{36} introduced an application of Lotka’s law at whole of authors with publication in the field of information science between 1996 and 2007. The results showed the data: one pending equal a ‘2,75’, the obtained it is lower in this camp; a percentage of authors, executors of one work only, it is equal a 79 percent and a excellent adjust of the Lotka’s law, to be application at the Kolmogorov-Smirnov.

Mishra, Panda & Goswami\textsuperscript{37} provided an insight into the citation analysis of research publications of the National Metallurgical Laboratory (NML) during the period 1972-2007. To validate Lotka’s law, they showed log-log plot of number of authors and number of citations in figure and concluded the low and medium productive cited authors are not a good fit but the high productive authors can be said as a good fit the original Lotka’s law.
Kumar\textsuperscript{38} examined the applicability of Lotka’s law as a general inverse power ($\alpha \neq 2$) and as an inverse square power relationship ($\alpha = 2$) to the distribution of the research productivity in CSIR, India. Two data sets of the research papers (6076 and 17681) contributed by CSIR’s scientists during the period of 1988-1992 and 2004-2008 were collected from SCI CD-ROM and Web of Science respectively. Kolmogorov-Smirnov (K-S Test) Test was applied to measure the degree of agreement between the distribution of the observed set of data against the inverse general power relationship and the theoretical value of $\alpha = 2$. It was found that the inverse square law of Lotka did not confirm as such.

Sen\textsuperscript{39} discussed the meaning of author productivity and research productivity and showed the difference between the two. He demonstrated that how simply the value of $c$ and $a$ pertaining to the equation of Lotka’s law can be calculated. The value of $a$ obtained according to the method described in the paper seems to be equally good, if not better than the value obtained through Pao’s method. The method is much simpler compared to Pao’s method.

### 2.2.3.2. Bradford’s Law

Basu\textsuperscript{40} discusses “Hierarchical distributions and Bradford Law”. While the distribution obtained reproduces the general shape of a cumulative frequency log-rank graph of publication data, to ensure good fit to data, a parameter has to be introduced, that may be considered to incorporate the effects of possible deviation from randomness and is suggested as an indirect measure of concentration.

Wagner-Dobber\textsuperscript{41} discusses about “Two components of a causal explanation of Bradford’s Law.” Instead of Bradford’s original rank size distribution he was taken equivalent but more general Pareto distribution while analyzing periodicals in 20\textsuperscript{th}
century psychology and mathematical logic and testing the hypothesis that hierarchy of subjects within periodicals correspond to the reception process, defined as the structure of interests of their readers.

Ravichandra Rao\textsuperscript{42} has made “An analysis of Bradford multipliers” to identify a suitable model to explain the law of scattering. Log normal model fits much better than many other models.

Bandyopadhyay\textsuperscript{43} studied the scatter of journal literature in different disciplines by a new scale of measure named AB’s coefficient of scatter from 11,228 citations appended to 92 theses of mathematics, physics, mechanical engineering, philosophy and political science submitted to the University of Burdwan, West Bengal, India for the period 1981 to 1990.

Devi\textsuperscript{44} conducted a study on a new derivation for Bradford’s Law of Scatter. This study highlighted the significance of Bradford’s law in information retrieval (IR) system with Information and Communication Technologies. The classical law was applied to the toxicology literature collected from the international database, Toxicology Information Online (TOXLINE) and its validity on that data was tested. The basic classical laws have been found fit for small data sets. It was found that these laws can be applied to new large data combined with contributions in other aspects such as theory development and model. The data was found unfit for the law. Hence a new formula is derived and applied which was found fit for the study.

Xu\textsuperscript{45} reported the standard procedure for Bradford analysis: export citations from research databases to a bibliographic management tool, separate the desired citation fields with bibliographic output styles, and then manipulate the empirical data, formulate graph and analyze linearity with Microsoft Excel. This study is mainly related to test the Bradford’s Law. This paper developed an easy operational procedure for manipulating and analyzing
the empirical data, formulating graph, and analyzing linearity, which could be a standard procedure for Bradford analysis. The experience and solution developed in this project can be used for a similar bibliometric analysis. This study concluded that the literature in systems librarianship follows the Bradford’s law.

Tunga\textsuperscript{46} analysed on 10,845 citations appended to 80 doctoral dissertations in horticulture, submitted to the BCKV and UBKV, West Bengal, during 1991-2010. Applicability of Bradford’s law was tested. The journal distribution pattern of the horticulture doctoral dissertations does not fit the Bradford’s distribution pattern.

### 2.2.3.3. Zipf’s Law

Samuelsson\textsuperscript{47} showed that Zipf’s law is closely related to the Good-Turing smoothing techniques, and a better law could lead to better smoothing. He explained that Zipf’s law implies a smoothing function slightly different from Good-Turing.

Sen et al\textsuperscript{48} presented the results of a study conducted to find out the validity of Zipf’s law related to the word length and the frequency of its uses in the case of library and information science literature. The results obtained from the analysis of six different samples obey Zipf’s law in all the cases with small deviations. The results provided by the sample comprising about 5,800 words fits the law best with just one deviation. The main exception is found to be one-letter words.

Power\textsuperscript{49} provided to revisit Zipf’s study of the relationship between rank and frequency of various linguistic and social units and constructions. The paper arose out of observations in natural language learning experiments of deviations from the received version of Zipf’s law.
Sun & Devis\textsuperscript{50} commented, studies of word frequency have many interesting and potentially significant applications. For example this model could be used to evaluate a single article or an author’s work. Assuming a reasonable level of skills among the writers whose works is the basis for our observations. We can use this model as a benchmark for assessing writer’s language skills.

Urzua\textsuperscript{51} presented a simple and locally optimal test for Zipf’s law. Its use was illustrated in the case of the largest US Metropolitan areas. An objection to the general relevance of that law was also presented.

Ferrer-I-Cancho & Sole\textsuperscript{52} showed that the co-occurrence of words in sentences relies on the network structure of the lexicon. They analyzed the properties in depth and commented that human language can be described in terms of a graph of word interactions.

Altmann\textsuperscript{53} commented that Zipf’s ideas are the foundation stones of modern quantitative linguistics and his influence is not restricted to linguistics but incessantly penetrates other sciences.

Ogasawara, Kawamoto & Okubo\textsuperscript{54} analyzed of human gene expression data revealed several patterns of relationship between transcript frequency and abundance rank. In muscle and liver, organs composed primarily of a homogeneous population of differentiated cells, they obey Zipf’s law.

\textbf{2.2.4. Citation Study of Doctoral Dissertations}

Lal\textsuperscript{55} by the method of citation analysis an attempt was made to identify the main sources of citations and prepared a list of the most important journals in various branches of agricultural science. In addition to it, a list of 59 most cited primary journals in order of
their merit was prepared. The geographical and chronological scattering of citations had been included. Libraries may to arrive at a need-based consideration in the selection and acquisition of journals within the limited sources.

Mubeen\textsuperscript{56} has studied 5012 citations of 22 doctoral dissertations in chemistry submitted to Mangalore University since its inception were analysed to study the information use pattern of researchers. The study has identified 60 core journals, out of total 418 journals, referred to by the researchers. The analysis shows that the researchers mainly depend on journal sources for their information use. It is evident from the study that an overwhelming majority use English as their primary medium for their research.

Gooden\textsuperscript{57} studied a citation analysis of 30 dissertations generated a total of 3704 citations, accepted in the Department of Chemistry at The Ohio State university between 1996 to 2000. The results collaborate past research by other authors. Journal articles were cited more frequently than monographs: 85.8 percent of the citations were journal articles and 8.4 percent of the citations were monographs.

Srivastava\textsuperscript{58} made a study of 18364 citations of 74 doctoral dissertations in chemistry, submitted in Benares Hindu University during the period 1980-1994. This study reveals that researchers under study have primarily depended on periodicals of chemistry and its allied branches for their source of information. The more cited periodicals and books were those published within 10-15 years from some preferred countries, viz. USA and UK, etc. The majority of citations were in English language.

Kuruppu & Moore\textsuperscript{59} conducted a study to examine the types of information used by graduate students on the citations of doctoral dissertations submitted in nine agriculture and biological science subject fields (crop production and physiology; molecular, cellular, and developmental biology; entomology; genetics; microbiology; plant breeding; plant
pathology; plant physiology; and soil science) at Iowa State University (ISU) from 1997-
2006. The article described the types and ages of resources cited in the different subject
fields studied. The most cited journals in each discipline were identified and the journal
title dispersion was examined.

Sasikala and Raju\textsuperscript{60} analysed of citations appended to 192 doctoral dissertations in the
field of Economics accepted by Andhra University has been carried out to determine the
use pattern of the literature by the researchers in economics. The study attempted to
identify the bibliographic form and subject wise distribution of citations, authorship
pattern, and obsolescence of literature in economics. The finding reveals that nearly 38%
citations were from books and 35 percent from journals. The subject distribution of
dissertations reveals that more than half of the theses submitted during the period are on
industrial economics followed by labour economics.

Vallmitijana and Sabate\textsuperscript{61} carried out on the citations within the chemistry field doctoral
dissertations to ascertain what types of documents are the most frequently used in the
research process, the most frequently consulted journals and obsolescence rate of the
journals. The analysis covered 46 doctoral theses presented at the Institut Quimic de
Sarria (IQS) from 1995 to 2003. The result obtained from the 4203 citations revealed that
the most frequently used documents were scientific papers, which accounted for 79
percent of the total; 33 journals met 50 percent of the information needs; and the age of
50 percent of the citations was no older than 9 years.

Olatokun & Makinde\textsuperscript{62} analysed the citations in master degree dissertations submitted to
the Department of Animal Science, University of Ibadan, Nigeria during the period 2000-
2007 for finding possible relationships between citing, cited articles and authors. Findings
showed that journals were the most utilized reference materials in the dissertations. Also,
Poultry Nutrition works had the highest number of dissertations followed by Agricultural Biochemistry and Nutrition.

Verma & Thakur\textsuperscript{63} studied 35 doctoral dissertations in the area of botany awarded in Pt Ravishankar Shukla University during 1966 to 2004 to determine the use pattern of literature in the area. A total of 7916 references were analysed for identifying their bibliographic form, authorship pattern, ranking of journals. The study revealed that journal is the most preferred by the researcher in the field of botany for accounting for 72.54 percent of total citations. The study and authorship pattern revealed that majority of the contribution are from single author. Researchers of this university are cited Indian journals mostly.

Raman & Varghese\textsuperscript{64} studied the citations of a sample 18 theses, selected at 10 year intervals to ascertaining the characteristics of the information sources used by the scholars. Analyzing the age of cited items, the obsolescence rate of literature in soil science was calculated. Median citation age was found to be 11.13 years. Chronological variation in the various characteristics of the cited literature was also examined.

Haldua, Arya & Kaushik\textsuperscript{65} used the reference lists of dissertations submitted by the doctoral students of the molecular biology and biotechnology sciences at the G B Pant University of Agriculture and Technology, Pantnagar, India during the period 1998-2010 and aimed to assist the library collection development in order to fulfill the needs of scientists and research scholars. The findings of the study showed that citation analysis is a valid, reliable and practical method to provide reasonable accurate information on the use of molecular biology and biotechnology literature by doctoral students. Publishing research in high-quality journals is an integral part of academic life.
Gawande & Choukhande studied 1450 citations appended to the 12 doctoral theses in the field of library and information science submitted to the Sant Gadge Baba Amravati University, Amravati during 1983 to 2010. It had been carried out to determine the use pattern of literature by the researcher in library and information science. Findings showed that journals are the most utilized reference materials in the theses as current literature and majority of citations found were 72.68 percent by single authored. Researchers largely use literature published in recent period and mainly from India and USA country. Application of Bradford’s Law in the present study revealed 5 journals covered 269 citations; next 16 journals covered 257 citations and the next 117 journals covered 228 citations.

Suma & Pillai Sudhier analyzed of 137 Ph D theses submitted during 2001-2010 found that majority of the theses (107) were in chemistry. The study evaluated the number of references included in the theses and found an average of 242.79 references to a thesis. Out of the 35 approved research guides, the maximum number of 21 theses was submitted under the guidance of Dr. G. Vijay Nair followed by 11 theses under the supervision of Dr. S.Das and 10 under Dr. A. Ghosh. One thousand five hundred and twenty one papers of National Institute for Interdisciplinary Science & Technology (NIIST) were included in the 124 theses out a total of 137 dissertations studied.

Tunga described the results of a citation study of cited horticultural literature appended in eighty doctoral dissertations submitted to the Bidhan Chandra Krishi Viswavidyalaya (BCKV) and Uttar Banga Krishi Viswavidyalaya (UBKV), West Bengal, India, during 1991-2010. 10,845 citations were appended in dissertations, of which, 8,437 (77.796%) were journal articles and 1327 (12.236%) were books. Scientists mainly use foreign
journals and foreign books for their research work than those of India. They prefer to publish their research work in Indian journals and Indian books.

2.2.5. Authorship Pattern & Research Collaboration

Mujoo-Munshi, Vashishth and Gautam\(^6\) has studied “Research collaboration in Agricultural Sciences” analysing about 9500 papers published during 1982-1986 by six agricultural universities in India. 15.36 percent of the articles were single-authored. The degree of collaboration is found to be 5.51 in agricultural sciences.

Farahat\(^7\) examined the patterns of authorship in nineteen ‘Egyptian Journals of Agricultural Science’ and found that multiple-authorship was predominant and co-authored papers were accounted as 79 percent of the sample.

Kumbar, Harinarayana & Tejaswini\(^8\) evaluated the authorship trend and collaborative research in the field of agricultural science using the data collected from ‘Indian Journal of Agricultural Science’ published during 2000-2001. The results showed that three authored papers were maximum 164 (34.02%) and the degree of collaboration in agricultural sciences is 0.87. Authors in the field have been ranked based on their academic productivity. The study indicated that contribution from research institutions and laboratories 190 (39.42%) is vividly ahead of other segments such as universities.

Sen\(^9\) has studied articles with ten or more authorship as the work of mega-authorship. The study conducted with a sample of 1294 papers published in the proceedings of the National Academy of Sciences of the United States of America during February-July 1996 showed that about 5 percent of the papers fall under the category of mega-authorship. He attempted to identify the causes of mega-authorship and discussed its
impact on author indexes, indexing services, citations, and the problem it may create in the identification of the principal contributor of a basic idea.

Visakhi & Srivastava\textsuperscript{73} studied to find emerging trend of research collaboration in the field of research collaboration in the field of statistical science during 1965-2000 using a abstracting journal entitled ‘Statistical Theory and Method Abstracts’ published by ISI (International Statistical Institute), Netherlands. The journal is covering approximately 4,500-6,500 articles from 250 core periodicals in statistical and allied fields annually.

Pillai\textsuperscript{74} did a study of the trends in authorship pattern and collaborative research in physics with a sample of 11,412 journals and 1,328 book citations collected from the doctoral dissertations of I.I.Sc. (Indian Institute of Science) and found that team research is being preferred and average value of degree of collaboration in journals was 0.08 and 0.44 for books. The authorship collaboration is more in journal articles than in books. The study concluded that authorship pattern, the degree of collaboration and the average number of authors were different in journals and in books.

Kumar & Kumar\textsuperscript{75} studied the collaboration in research productivity since the establishment of five major oil seed research institutes in India till the year 2006. Analysis included types of communication channels used and the authorship patterns. Result found that only 21.33 percent publications are single authored & the collaboration coefficient ranges from 0.709 to 0.845 in various institutions. Overall coefficient is 0.781.

Nandi & Bandyopadhyay\textsuperscript{76} studied of 67 doctoral dissertations and 610 articles based on these dissertations submitted by the scholars during 1960-2000 in the Department of physics at the University of Burdwan. Result found that authorship trend was towards multi-authored papers and the degree of collaboration was 0.73.
Pradhan, Panda & Chandrakar\textsuperscript{77} analysed the trends in authorship pattern and author’s collaborative research in Indian chemistry literature with a sample of 53,977 articles downloaded from SCI –Extended database in Web of Science during the period 2000-2009. The average number of authors per article is 3.55 percent. In the study the degree of collaboration during the overall 10 years (2000-2009) is 0.03, but the year wise degree of collaboration is almost same in all the years of mean value 0.97. In the ten years period, the multi-authorship articles are higher and predominant on single authorship. The study found that the researchers in chemistry are keen towards team research or group research rather than solo research.

Arya\textsuperscript{78} studied authorship pattern and collaborative research trends in the field of veterinary medicine based on the data collected from ‘Indian Journal of Veterinary medicine’ published during the period 1999-2007. Observations show that multi authored papers (95.55%) predominate single authored papers (4.45%). The degree of collaboration in the field of veterinary medicine is 0.96%. Average number of author per paper varies from 2.92-4.08.

2.2.6. Self-Citation Study

So\textsuperscript{79} in “Openness index and affinity index: two new citation indicators” has discussed some design issues in the self-citing rate and self-cited rate proposed by Social Sciences Citation Index for journals. The new indices are expressed in terms of several components. The revised self-citing rate signifies the degree of closure of a journal to all other journals. All other things being equal, a journal with a high self-citing rate means that it is relatively “closed”, seeking intellectual inputs only from itself.
Bonzi & Snyder\textsuperscript{80} investigated the motivating factors in self-citation of 51 self-citing authors in several natural science disciplines. The results of the survey on reasons for both self-citation and citation of others indicated that there were very few differences in motivation and that there were plausible intellectual grounds for these differences. The study also showed that there was no difference between self-citation and citation of others in text.

Mahapatra & Kaul\textsuperscript{81} studied “Self-citation by Indian botanists” through analysis of 265 articles published in the “Bulletin of the Botanical Survey of India” during 1981 to 1987. Out of 3286 citations 444 (13.51\%) were self-citations.

Maczelka & Zsindely\textsuperscript{82} investigated the impact and the journal self-citation rate of 22 newly launched chemistry journals. Their analysis indicated that the dependence of these indicators on the journal’s age was found to be characteristics of the initial period of a journal’s life cycle.

Dimitroff & Arlitsch\textsuperscript{83} examined 1058 articles to determine the rate of self-citation in library and information science literature. They found that 50 percent of the articles contained at least one self-citation. The self-citation rate of 50 percent is higher than previous studies of self-citation rates in the sciences and social sciences. The percentage of self-citation as related to total citation count is only 6.6 percent which falls between the percentage reported in the sciences and other social sciences.

Tiew\textsuperscript{84} analysed the extent of journal self-citation and author self-citation in the research articles and short communications published in Journal of Natural Rubber Research during 1988 to 1997. Results showed that 53 percent of articles contained journal self-citations; the rate of journal self-citations per article ranges between 1to12; a high percentage of authors (61.4 percent) contributing articles to the journal cited themselves.
2.2.7. Obsolescence Study

Arunachalam & Manorama\textsuperscript{85} produced data that sources cite in journals in the developing countries tend to be much older than those cited in the journals of the most developed nations. For an Indian journal in environment sciences they found that only about 14 percent of the sources cited were 4 years old or less, while 53 percent were more than 10 years old.

Vimala & Reddy\textsuperscript{86} studied of the obsolescence of literature helps librarians to maintain the need based collection of literature. Citations form 128 doctoral theses in zoology submitted to Sri Venkateswara University, Tirupati, India, during the period 1962-1994 forms the basis for the study. It is observed that the citation frequency follows a negative exponential pattern. Half life of literature is found to be 13 years for journal citations and 13.27 years for book citations.

Biradar & Sampat Kumar\textsuperscript{87} in their study examined Annual Aging Factor (AAF), Mean Life (ML) and Utility Factor (UF) of periodicals in the field of Chemical technology. The study is based on references appended to the articles published in Indian Journal of Chemical Technology during three years.

Tonta & AI\textsuperscript{88} in their article analyzed the bibliometric features (the number of pages, completion years, the fields of subject, the number of citations, and their distribution by types of sources and years) of 100 theses and dissertations completed at the Department of Librarianship of Hacettepe University between 1974 and 2002.

Pillai & Sudhier Pillai\textsuperscript{89} reported results of a study to examine the obsolescence of literature in physics by citation analysis. Citations from 71 doctoral theses in physics
awarded from the Indian Institute of Science, Bangalore, India during the period 1999-2003 forms the basis of the study.

Pillai\textsuperscript{90} examined the obsolescence literature in physics by citation analysis and reviewed various studies already in the field and outlined the results. The study was based on the 3180 citations, cited in the 12 doctoral dissertations of physics awarded from the Department of Physics, University of Kerala, India during the period of 1999-2003. The findings showed that the half life of journal citations was 14 years and for books it was 25 years. The mean year of journals was calculated as 17.58 and 23.09 years for the books.

Zafrunnisha & Reddy\textsuperscript{91} attempted to discover the obsolescence rate of psychology literature cited in the doctoral theses awarded from 1963 to 2005, at S. V. University, Tirupati; Osmania University, Hyderabad, and Andhra University, Visakhapatnam. The study focused the different characteristics of the literature on the citations.

Mulla, Dhanamjaya & Talawar\textsuperscript{92} studied the obsolescence of engineering literature cited in 137 doctoral dissertations of engineering and technology awarded in six general universities of Karnataka during 1961 to 2008. The study revealed that, the overall of 7467 citations of periodical articles and 2014 book citations are scattered primarily among fifteen subjects. However, citations were derived from early 1990 to after 2001, 86 percent of books cited by engineers and technologists in their Ph D theses were of 9-39 years recent associated an outsized share of the journal citations (68.58\%) utilized by the researchers was published 20 years back or whereas older than the recent ones.

2.3. Conclusion

On the basis of the preceding review of the literature and discussion, it may be concluded that bibliometric studies are very useful for horticultural researchers for evaluating
prolific authors and institutions; ranking of journals, authorship pattern, geographical
distribution, chronological distribution and obsolescence study of the cited documents.
These studies have the potential to determine the growth and development of horticulture
field. Bibliometric methods have been effectively utilized to solve a variety of issues in
horticulture. Thus, above review suggests that literature citation and bibliometric analysis
has received a great deal of attention since its foundation. Bibliometrics is basically a
quantitative analysis of publications for the purpose of establishing specific kinds of
phenomena. The vast majority of bibliometric studies have been dedicated to scientific
and technological disciplines. According to the literature citation analysis has been also
used by librarians in various disciplines to eliminate costly low use/unused journals,
purchase needed materials and ascertain core journals needed for patron use and to reveal
the most active research in a particular. This study has various practical applications in
library management and it also provides an aid to quantify research and growth of
different areas of knowledge.

The situation of horticulture research needs to be analysed to explore trends and provide
base for future research. The present study builds on previous studies and seeks to use this
method to aid in collection development in the area of horticulture. Ideally, examination
of past material use (particularly journals and books) should suggest future materials use
by horticulture doctoral students. Hence, the aim of present work is to present the analysis
of the characteristics of horticulture literature from doctoral dissertations with the help of
bibliometric techniques.
References


