CHAPTER 2
CHAPTER 2
REVIEW OF LITERATURE

2.0 Introduction

In this chapter the literature review pertaining to this study is discussed and analyzed. This review will focus on the research already carried. Bibliometric, scientometric and informatics analysis method of study are employed for this.

Scientometrics analysis received more attention in the recent years due to rapid increase in science literature. It also describes the output traits in terms of organizational research structure, resource inputs and outputs, and develops benchmarks to evaluate the quality of information output. It further characterizes the disciplines using the growth pattern and other attributes.

Review of literature identifies the current knowledge in this field. It points out the methodology, objectives, hypotheses and database use on one hand and on the other the limitation of the study, in this field. Such a review is very advantageous in the following aspects:

- Through the review of literature the duplication of work is mostly avoided
- Such a review helps the researcher in understanding both content and methodology.
- It helps to improve the quality of research
- It helps to find out the popular researcher in this field and make the researcher look at research work from several angles.

The researcher selected one hundred and seven articles for review study. He reviewed thirty five articles under subject category, thirteen papers under journal reviews, twenty two articles under country review, nineteen publications under the
nstitute cadre review and seventeen under scientists (authors) review. This review of
iterature has been classified as follows:

2.1 Scientometric study by subjects
2.2 Scientometric study by journals
2.3 Scientometric study by countries
2.4 Scientometric study by institutions
2.5 Scientometric study by Scientists

1 Scientometric Study By Subjects

Scientific publications have long been characterized as the channel of
communication in science. In this connection one has to agree with Merton (1973)
that no scientific research is complete without its formal dissemination, prominently in
the form of journal publication. As such, the number of papers produced by a scientist
of a given institution is a measure of both the scientist’s productivity and the
institution’s scientific output. The measure of scientific productivity by its
scholarly publications has evolved, based on the norm among scientists,
characterizing science as “public knowledge”. Research is not complete until its
findings are made known to the scientific community.

Natale et al (2012) in their paper entitled “Mapping the research in
aquaculture: A bibliometric analysis of aquaculture literature” examined the
aquaculture literature using bibliometric and computational semantic methods. The
chief aim was to identify the main theme and trend in the field of aquaculture which is
expanding along with the exceptional growth of the sector and has an important role
in supporting even further the future developments of this relativity young food
product industry.
Sankar and Srinivasa Raghavan (2012) conducted an analysis of Indian Horticulture research publications. The study was published under the title "Horticulture Research in India: A Scientometric study". From this it becomes explicit that Mitra S K produced largest number of articles among all the contributor and that during the year 2010 ‘ACTA Horticulture’ published the largest number of articles. Further the most cited reference is Jackson’s ‘Soil ‘Chemistry’.

Mamdapur et al (2011) analysed articles in Baltic Astronomy published during the years 2000 to 2008. It was found that the author’s degree of collaboration for the period 2000-2008 was 0.89. The other findings were that the authors have primarily relied on journals followed by books, conference proceedings and reports, and authors from the USA contributed maximum number of papers compared to other countries and India stood 21st in the ranked list. Further it was found that Astrophysical Journal topped the ranked list of journals cited by the authors.

Borsi Schubert (2011) conducted research and presented a paper entitled "Agrifood research in Europe: A global perspective". They found that publications on agrifood from the United State of America were most influential as judged by the average citation rate per paper. Further it was found that there existed a correlation between economic power and agrifood science publications. This is true not only for the total number of papers, but also for influence (measured by, again, the citation rates). Within Europe, the UK, Germany, France, Spain and the Netherlands dominate the agrifood research fields as also in terms of citations. The Scandinavian countries, the Benelux states and Switzerland manage to produce influential papers across several fields of agrifood science.

Balasubramanian and Ravanam (2011) for their study analysed global agricultural research publications using the web of science, during 1945-2010 and
presented an article bearing the title “Scientometric Analysis of Agriculture Literature: A Global Perspective” It was found that global agriculture research has registered an upward trend, which has been confirmed based on the quantity of literature published in the past 66 years. As regards to country wise distribution of publications in agriculture, the United States stands as the top most country in publishing research articles on Agriculture. The most preferred journal by the scientist writers is “Agriculture Ecosystem and Environment” in which 533 research articles were published. In addition to all these, ninety percent of the published articles are written in English. Further, according to these two writers, the impact of agriculture research implies the use of various power source and improved farm tools and equipment, with a view to reducing the drudgery of the human being and draught animal, enhance the cropping intensity, precision and timelines of efficiency of utilization of various crop inputs and reduction of the losses at different stages of crop production and have high priority has to be bestowed on Agriculture research by the scientists.

Ravanant et al (2010) have published a research paper entitled “Scientometric analysis of Coconut Literature: A Global Perspective”. The study analyzed coconut literature based on Scopus database. They found that coconut research publications have registered an upward trend, and that India is among the highest coconut producing countries. As regards to the institutions producing coconut literature, the Central Plantation Crop Institute stands at the top and Prof P.C. Calder has produced the largest number of research papers in India on coconut. All this literature has been written in English and maximum number of articles has been written on Bioresource Technology.
The study “Scientometric assessment of publishing patterns and performance indicators in agriculture in the JCEA member countries” under taken by Bartol (2010) assessed selected characteristics of documents published in national journals and other publications in the countries which participate on the editorial board of an international journal JCEA (Journal of Central European Agriculture). Bibliographic citations from the CAB Abstracts database were employed. Search syntax along with some cataloging characteristics of the database was addressed. In total more than 89,000 agriculture-related documents were identified in the period 2000-2008 with journal articles predominating, followed by proceedings (conference papers). English plays the role of the principal language, accounting for more than half of all records (48,000). Poland is the major contributor of documents. Croatian publications show the highest level of international participation in domestic publications, whereas the Slovenian authors show the highest level of publishing in non-domestic publications. Altogether some 378 different agricultural and related life and environmental sciences journals have been active in the region in this period. The results can serve as an indicator of regional publishing activities and behaviour of authors.

Lalit Mohan (2010) and et al, contributed the paper “Research Trends in Nanoscience and Nanotechnology in India” This paper attempts to highlight quantitatively the growth and development of Indian research in the field of Nanoscience and Nanotechnology in terms of publication output as per Science Citation Index (1982-2008) The yearly average number of documents published was 308.37. The highest numbers of publications (1890) were published in 2008.

Rojas-Sola and Antonio-Gómez (2010) published the article entitled “Bibliometric analysis of Argentinean scientific publications in the Agriculture, Multidisciplinary subject category in Web of Science database”. The aim of this study
was characterize the subject area of agriculture, multidisciplinary in Argentina, reviewing at institutional level, the work done by researchers at institutions in Argentina and published in international journals with impact factor from 1997 to 2009, through the Web of Science database. In the context of Latin America, 7795 published works of all types and 7622 article or reviews in 49 journals were published. Taken Argentina alone they have found 531 articles or reviews published in 31 journals, mostly in English (80.23%), and remaining in Spanish (15.25%) and Portuguese (4.33%).

Garg et al (2010) wrote research article bearing the title “Scientometric profile of ‘genetics and heredity’ research in India” The writers presented an analysis of 2899 papers published by Indian scientists during 1991-2008 using Science Citation Index. The analysis indicates that the growth of publication output was slow in the initial stages, but started increasing after 2000. The highest output was in the sub-field of molecular genetics. Academic institutions contributed the highest number of papers but had less impact as compared to other performing sectors. Research had the lowest impact as far as the papers published by Indian Council of Agriculture are concerned. Among the institutions, Madras University had the highest impact, while Indian Veterinary Research Institute had the lowest.

Alex and Balaji (2010) undertook the analysis of the papers written in India on climate change under the head “Mapping climate change research in India: A bibliometric approach” A total of 25081 papers were published in the field of climate change science during the five year period 2005-2009 which were undertaken for analysis. There were only 391 publications produced from India, which is approximately 1.55 percentage of the world output. The analysis of the literature
during the 2005-09 years indicates a steady growth observed in the successive years from 2005 onwards.

A bibliometric study on biological invasion literature was undertaken using Web of Knowledge during 1991-2006 by He, P., Lu, W.-R., Luo, Y.-Q. A (2009) the results derived from this study indicated that, among all nations, the United States had the largest number of publications, accounting for 41.8% of all related publications worldwide. The average impact factor of the top 10 journals publishing related articles was 4.03. Three journals - Biological Invasions, Ecology and Cancer Research were the most important and popular ones in this field. The Chinese Academy of Sciences, Fudan University, and Hong Kong University were the top three institutions that had the highest numbers of publications with the lowest number coming from the first.-‘Quality in China’.

Wenning Xiang, Yangge Tian and Shuang Deng’s (2009) article bearing the title “Comparison of GIS paper between SCI and EI database using bibliometric analysis” is a comparative study. It found that GIS research has steadily increased in both database of SCI and EI and concluded that bibliometric methods could be used in the comparative studies in specific research field.

“Using bibliometric analysis to evaluate global scientific production of data mining papers” is the title of the paper written by Shuang Deng et al (2009). The study used web of science database. The analysis shows that data mining research steadily increased over the past 20 years and the annual paper production in 2007 was about three times that of 1999. It was further found that the USA, China, Germany, England and Canada are the most productive countries.

Jeenah and Pouris (2008) undertook the study under the head “Scientometric assessment of research in South Africa” in the context of the rest of Africa and in
comparison with Brazil and India – two countries with which South Africa aims to develop strong scientific ties. They found that South Africa has published a significant number of papers in all 22 disciplines represented in the ISI’s Essential Science Indicators. The largest numbers of journal articles during 10-year period (1996-2005) were published in the categories of Clinical Medicine, and in Plant and Animal Sciences, with over 7000 papers each broadly falling under three groupings, namely, Chemistry, Geosciences, and Environmental/Ecology.

A scientometric study was undertaken to assess the quantitative trend of “patent literature in MEDLINE throughout 1965-2005” by Biglu (2009). The study showed that the growth of patent literature in MEDLINE registered an annual growth of 11.4%. It also indicated that more than 90% of all documents indexed as “patents” in MEDLINE were in English, and that ‘Genes and Genetics’ was the most frequented Major MeSH Descriptors (Main Heading) in MEDLINE throughout the period of study, besides scientometric study of patent literature in medicine.

Mohan (2007) conducted studies connected with seaweed and produced the paper entitled “Mapping of seaweed research: A global perspective” This study shows country wide productivity of seaweed literature in India. He found that India ranked fourth in research in this field with steady increase in productivity and similar kind of trend in other countries too as regards to seaweed research.

Patra and Mishra (2006) in this article “Bibliometric study of bioinformatics literature” analysed the growth of bioinformatics literature using PubMed data base. The result shows Bioinformatic literature was growing at an exponential rate and recorded an all time high in the year 2004. Judged by the trend of the years 2004 and 2005 the rate of growth has been predicted to be around 4,000
articles per year, clearly indicating that it is a significant and an emerging field of science.

Two studies similar in nature to the present study were conducted by Anwar (2005; 2006). “Phoenix dactylifera L.: A bibliometric study of the literature on date palm” was the first study conducted in 2005. He studied the periodic growth, authors patterns, subject focus, and geographic origin of the literature pertaining to Nigella sativa, commonly known as the Black seed. He analyzed 530 citations and found that most of the literature came from medical sciences and chemistry; and India and Egypt were the leading contributors. It was further observed that most publications were co-authored and English was the main language.

In another study undertaken by the same author-Anwar-in 2006, he examined data palm literature and published a paper on this research, bearing the title “Nigella Sativa: A bibliometrics study of the literature on Hobbat AL-Barakah” Using bibliometric analysis, he identified 2,465 citations and found that most of that literature originated from Iraq and Egypt and that English was also the most used language; other findings were that a small core of authors were responsible for one-third of the publications, and that the literature was also interdisciplinary, primarily covering the fields of agriculture, biological sciences, and chemistry.

Philippe vain (2006) examined plant transgenic science and presented an article entitled “Global trends in plant transgenic Science and technology (1973-2003)” The study analyses plant transgenic science publications. The statistics showing the coverage for the past 30 years reveals a dramatic increase in the study on plant transgenic science in Asia during the past decade besides a sustained expansion in North America but, of late, a slow down in the rest of world.
Kumbar et al (2005) carried out research and wrote an article entitled “Authorship trend and collaborative research in Agriculture Science” In this study they have studied the authorship pattern and collaborative research in agricultural sciences.

Krishna and Kumar (2004) presented article entitled “Authorship trends in agriculture research: A bibliometric analysis”. The study analyzed 8,401 citations used in 68 theses dealing with agriculture submitted to Indian universities from 1996 to 2000. They have examined the subject distribution, authorship pattern and trends of research on agricultural and veterinary sciences.

Kumar and Gupta (2003) in their article “Modeling the growth of literature in the area of Chemical Sciences” reviewed the different approaches for studying the growth of scientific knowledge, as reflected by publication, and explored the applicability of selected models in the growth of world research output in the form of articles, patents and books in the field of chemical science.

Vijayakumar et al (2002) studied the popular medicinal tree-Neem-grown in South Asia. Its scientific name being Azadirachta Indica, the title of the article reads “Authorship trends in Azadirachta Indica Literature: A bibliometric study”. All the papers written on this tree from 1989 to 1999 were discussed using biological abstracts. They found that 89.02% of 1,111 papers were written by multiple authors whereas 27.4% of the papers were contributed by single authors. Ten (3.3%) of the 300 journals published 24.0% of all papers and 56% of this literature was produced in India and that 96.4% of all papers were in English. They identified 28 (9.3%) titles as core journals for this literature.

Ramesh et al (2000) analyzed the papers published on ‘Oryza’, from 1986 to 1995. Based on this they wrote an article entitled “Publishing pattern in Oryza
(Oryza L) from 1986 to 1995: A bibliometric study”. This article presents different areas of work and the relationship.

Tracing and comparing the trends in the growth of literature pertaining to food science and technology were undertaken by Seetharam and Ravichandra Rao (1999). The study threw light on the fact that the growth declined gradually from decade to decade. From 109% growth rate of food science paper during 1961-70, it became 71% during 1971-81 and 45% in 1981-1990.

Bhat (1995) submitted an article entitled 'Literature published during the past two decades on medicinal, aromatic and other related group of plants". The study examined two decades of records -1973-1993 in CAB Abstracts. Some 50,000 citations covered such topics as medicinal plants (52.5%), pesticidal and poisonous plants (24.2%), and herbs and spices (12.0%). One of the conclusions of the study was that the volume of literature published annually had at least tripled over this period.

Barreveld (1993) “Date palm products Rome: FAO” a comprehensive work on date palm products includes a bibliography of 618 titles of various types. This is a very extensive bibliography but most of its citations are incomplete. An Indian publication that reviews research on date palm grown in its Thar Desert area includes a bibliography of 104 items.

Thorpe (1990) published an article bearing the title “The generation and transfer of agricultural knowledge: A bibliometric study of a research network” The writer made a study of agricultural research activities which were developed to assist in the evaluation of the knowledge transfer component of an agricultural research network involving the six southern core countries of South America (Argentina, Bolivia, Brazil, Chile, Paraguay and Uruguay).
Chadwick and Craker (1988) presented their study under the head “The scientific literature on herbs Science”. The article reviewed and evaluated the literature on herbs for the purpose of providing a list of information sources that would assist librarians in building scientific and technical collections. They found that the herbal literature was limited and widely scattered resulting in a lack of accessibility for libraries.

Meera (1988) published an article “Plant ecology literature: A bibliometric study”. The study highlights the characteristics of 4,840 citations on plant ecology derived from papers published during 1994-1995 in terms of their subject, language and geographic dispersion, and author and journal rankings.

Adenaike (1982) carried out a study. His article “Bibliometric studies on a protein-rich crop: The cowpea” is based on that. The analysis shows some characteristics of the citations taken from two bibliographies on cowpea covering the period from 1888 to 1973. The writers arrived at the following conclusions:

1. The literature doubled every twenty year.
2. Eighty seven percent of this literature is being produced in English language,
3. Journals were the most popular medium of publishing.

2.2 Scientometric Study By Journal

Scientific journals are the means by which the scientific community certifies accumulations and additions to its body of accepted knowledge and the means through which scholars are compete. Individual journals have been the focus of many bibliometric and scientometric studies. Certain important agriculture related studies are mentioned below:
“Bibliometric study of Indian Journal of Agriculture Chemistry” is the paper written by Bakkiaraji, and Jayakumar (2012). It was found that the maximum number of papers was published during the year 1999, and the authorship pattern showed that two-authored publications occupy of the first position. Further it was found that the degree of collaboration was an average of 0.72%. The period wise analysis indicates that this level was more or less equal during the period 1999-2008.

Ramesh and Natraj (2012) conducted a bibliometric study and submitted it as a paper entitled “Indian Journal of Agronomy Articles: A Bibliometric study”. The year wise distribution of articles indicated that the maximum number of articles was published in 2008 and 2010. Considering the authorship pattern it was found that two author articles occupied the top most position. The analysis of subject wise distribution of article showed that irrigation management was the most discussed topic followed by weed management, fertilizer management, soil chemistry and crop production, in that order.

Kannappanavar and Roopashree (2011) published research paper bearing the title “Journal of Genetics: A Bibliometric Study”. The study found that there are more articles written by multiple authors rather than single author. It was found that USA contributed more number of papers than any nation. As regards to citation, more than 48% of the journals cited were from the USA. Further it was found that the maximum citation was from the journal ‘Genetics’ followed by ‘Science’, both published in the USA. Another interesting information was that the Indian Journal ‘Journal of Genetic’s occupied the fourteenth position.

Ming-Huang (2011) published a research article bearing the title “Research Article Published in Water resources journals: A bibliometric analysis” This study revealed many significant points as regards to world wide research performance in...
the field for the period 1994 to 2008. This paper analyses 16 years articles on water resource using Web of Science database during 1993-2008. In this study on the article in the category of water resources journals listed in SCI-Expanded, significant points on worldwide research performance from 1994 to 2008 were revealed. It was found that the United State Geological Survey was the pioneer in the field of water resources, with the most independent, inter-institutionally collaborative, first author, and corresponding author articles and that the h-index (64) of the United State Geological Survey was the highest. The most frequently cited paper each year was a backstage pioneer in the research field and observed researcher with a panorama of global water resources research and established further research directions.

Garg and Kumar (2010) undertook an analysis of 5317 articles and reviews published in 46 Indian science journals indexed by Science Citation Index Expanded (SCIE) during 2006, and presented the paper “An analysis of the citation pattern of Indian science journals indexed by SCIE” It was found that these journals predominantly published domestic papers. About 40 percent of the papers published in these journals were cited in the international literature during January 2006-June 2009. The proportion of cited papers and the rate of citation varied for domestic, foreign and collaborative papers, as well as among disciplines and publishers. The analysis indicated that collaborative papers had the highest rate of citation per paper. The Indian Journal of Medical Research published by Indian Council of Medical Research, New Delhi had the highest citation impact. The highest number of papers cited was from the discipline of medicine.

Biswas et al (2007) carried out a study and produced the articles “Economic Botany: A bibliometric study” It examined the content and characteristics of the journal ‘Economic Botany’ from 1994-2003. They found that certain subject clusters
such as ethnobotany, traditional and folk medicine, plant products, and phytochemistry dominated the literature. The majority of the papers were co-authored. Further, most primary authors were affiliated with academic institutions, and the articles originated from 45 countries with the United States leading, followed by the United Kingdom.

**Ezhilrani et al (2006)** submitted paper on “Authorship pattern and collaborative research in aquaculture journals”. It described the authorship pattern and collaborative research by analyzing selected journals on aquaculture.

**Tilik Hazarika (2003) et al**, conducted a study on and wrote a paper entitled “Bibliometric analysis of Indian Forester 1991-2000”. The study found the number of papers published in the Indian Forester from 1991-2000, inconsistent. The maximum numbers of papers are found in the area of Silviculture (30.67%) followed by Ecology, Environment and Biodiversity (8.42%) and minimum in legal aspects of forestry and the IPR.

**Hasan and Sing (2003)** carried out a study and prepared a paper bearing the title carried “Agricultural research in Himachal Pradesh: A profile based on Agricola”. The authors have carried out a bibliometric study on Himachal Journal of Agricultural Research by using different parameters and authorship pattern.

**Ramesh and Nagaraju (2002)** attempted a study and produced the paper “Publication pattern in International Journal of Tropical Agriculture 1991-2000: A bibliometric study” They have made a bibliometric study of International Journal of Tropical Agriculture to find out year-wise distribution of papers, authorship pattern and collaborative research.

**Surayananarayana’s (2000)** study resulted as an article entitled “Bibliometric analysis of contributions of journal of Tobacco Research”. The study identified and
analyzed the papers and the citations published in the journal ‘Tobacco Research’ for the period 1987-1997 to find out year-wise distribution, collaborative research, authorship pattern and the like.

**Sivasubramanian (2000)** undertook a bibliometric study and submitted the article “Journal of Indian Coffee: A Bibliometric study”. Through his deft analysis he identified the nature and pattern of authorship and the degree of collaboration in coffee research and reported that publication trends among coffee scientists centered on single authorship with high degree of collaboration in coffee research.

“Citation analysis of Indian journal of Genetics and Plant Breeding” is an article written by Lal (1993). The study found authorship pattern and prepared a ranked list of journals from the viewpoint of soil scientists working in India.

**Sarala (1990)** conducted a bibliometric analysis of the Journal and prepare the article “A Bibliometric Analysis of the Journal of Tropical Agriculture”. The results of a bibliometric study of papers published from 1989-1994 in the Journal of Tropical Agriculture. An official publication of Kerala Agricultural University, were worked out. 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, beside a ranked list of the 30 most commonly cited periodicals. It was noted that Indian journals occupied eight of the top ten positions in the ranked list.

### 2.3 Scientometric Study By Country

Literature indicators have been used as indicators of scientific performance of organizations and countries based on counts of publications and citations in the scientific literature (**Chidambaram 2005**:Balram2008). Having
attempted scientometric study by subjects and then by journals a study by country is attempted below:


It shows that studies that were conducted elsewhere than South Africa tend to neglect in their analysis important gender related and factor such as sex composition of multi authorship. Based on the analysis of Web of Science database from the period 1999-2002, it has been observed that foreign co-authorship is better correlated of high citation than the sex of African authors, and this is true irrespective of whether the annual is citation rate or windows-period is used or the number of authors is for by calculating fractional counts.

**Onyancha Omwoyo Bosire et al (2011)** attempted a study related to informatics analysis in this field and produced a paper bearing the title “Research Collaboration between South Africa and other Countries 1986-2005: An Informatics Analysis”. They use AGRICOLA and ISI database from 1991 to 2005. The paper reports the finding of Informatics study of the countries with which South Africa collaborates in research. It was observed that multiple country author papers as well as the number of collaborating countries are on the rise since 1986. Further the USA topped the list of the countries outside Africa collaborating with South Africa while Zimbabwe topped the list of African countries.

**Garg (2011)** et al undertook a study and presented a paper entitled “Plant genetics and breeding research: Scientometric profile of selected countries with special reference to India”. In this analysis it came to be known that a total number of 32,574 papers were published in the USA, the UK, China, India and Brazil in the
field of ‘plant genetics and breeding’, Research during 2005-2009 indicates that the USA produced the highest number of publications followed by China. The impact of research output as seen by the values of different impact indicators is highest for the UK and India contributed about nine percent to the world publication output in this branch of knowledge.

**Balasubramani and Murugan (2011)** have published in the study entitled “Mapping of Tapioca (Sago) Research in India: A Scientometric Analysis” The findings of study are as follows:

The average yearly number of publications during the years from 1975 to 2009 was 12.08. It was observed that the growth of the relevant literature was very low during 1975 and 1976 and peaked during the year 1997, 1998 and 2009, further it was found that India occupies the place of Tapioca top producing country followed by the UK, which is second.

**Khatun and Zabed (2011)** carried out a study and submitted a paper on bibliometric analysis entitled “A bibliometric analysis of diarrhoeal disease research in Bangladesh”. The paper traced the literature growth, authorship pattern, collaboration and journal distribution on diarrhoeal disease research in Bangladesh based on data obtained from PubMed, Web of Science and Scopus databases. The result shows increasing R and D activities on diarrhoeal research in Bangladesh. It was found that Lotka’s law and Bradford distribution do not apply to diarrhoeal disease research in Bangladesh. Further, the $h$-index count indicates that Bangladesh tops the diarrhoeal research impact list in South Asia region.

**Gupta (2010)** presented a research paper bearing the title “Mapping of Indian Science and Technology output in National and Global context (1997-2007)” This study compares overall Science and Technology publications output of India, China
and South Korea across twenty broad subjects as defined by Scopus bibliographical database. The result indicates that China has a clear edge over South Korea and India. In terms of global publication the highest average growth rate was 23.40 and h-index value 23.40. The highest share international collaborative publications were as follows: China 12.38%; South Korea, 21.75%; India 15.85%, As regards to citation the shares are as follows; South Korea 0.464%, India, 0.23%; China, 0.174%.

Senthilkumaran et al (2010) presented the paper “Quantitative analysis of R and D output on plantation crops in India”. The analysis from 1998 onwards shows upward growth of literature in tea, coffee, rubber, cashew nut, cocoa and oil palm but publication seems to be fluctuating in their R and D focus yearly. It was found that are among the plantation crops areca nut leads all as subject of research.

Arguimbau (2008) published an article on "Global trends in research resources and scientific output in microbiology in Spain" The study recorded scientific output in microbiology in Spain. This study shows that there is a positive trend regarding research projects and scientific articles. The scientific research output of Spanish microbiologists’ ranks 6th in the world, which is higher than the ranking of Spain with respect to economic development.

Aiten Michelle Picard and Gregoine cote (2008) did a project and submitted the article “Analysis of Scientific collaboration between Canada and California” The study found the following:

The number of papers published in California is 422000 and those published in Canada come to 31800 which mean that California published 25% more papers than Canada. The increase registered by Californian researcher was 25% between 1997 and 2006 whereas it was 20% for the same period in Canada. In both the regions the number of papers published per capita is almost the same, was and 1.2 papers per
thousand inhabitants. Further it was found that California’s ARC score in 1.63 and that of Canada 1.21.

At global level scientific output in science and technology are growing at the fastest rate followed by science related to the earth and space and then mathematics. At the same time it has been found that research growth in the field of biology and biomedical research is slower in both Canada and California when compared to the other countries of the world. The growth index of Canada’s research in engineering and technology, physics and mathematics is higher than California but not in the field of earth science and space. It has also been found that scientific production in chemical medicine is holding steady in Canada and California whereas at world level this production is decreasing.

Larsen et al (2008) having undertaken a study submitted the findings in the article entitled “Scientific Output and Impact: Relative Positions of China, Europe, India, Japan and the USA”. They analysed publication outputs and respective shares of scientific publication for the period 1981-2004 pertaining to China, Europe, India, Japan and the USA. The share in the total number of publications has been stagnating or gradually decreasing in recent years for Europe, the USA, India and Japan although there is no absolute decline in publication activities. The most dramatic trend has been the fast growth in China. The USA is still maintaining a lead in publication impact. The impact from European countries, Japan, China and India has increased but is still far behind that of the USA.

Similarly, Leung Chan and Song (2006) presented their analysis in an article “Publishing trends in Chinese medicine and related subjects documented in WorldCat”. The paper examined publishing trends in Chinese medicine, Chinese pharmacy, and acupuncture as documented in WorldCat. Their findings showed that
there were 45 languages found in the database, with English constituting the largest share (53%). For obvious reasons, monographs constituted the major format and understandably most of the records were from the twentieth-century.

**Frederic and Grégoire (2006)** presented a research article entitled “25 years of Canadian Environmental Research: A Scientometric Analysis (1980-2004)” . The study reveals that significant growth has taken place in international environmental scientific research during the eighties of the 20\textsuperscript{th} century and more than 15100 research papers were published annually on environmental research. The year 2004 registered an increase two times. This growth is higher than the one observed for all papers indexed in the SCI database. Over the last 25 years the number of environmental research papers has increased 2.3 times, while the number of papers in all scientific fields has grown 1.6 times.

**Molatudi and Pouris (2006)** submitted a research article with the title “Assessing the knowledge base for biotechnology in South Africa: A bibliometric analysis of South African microbiology, molecular biology and genetics research”. The article examined the status of microbiology, molecular biology and genetics research in South Africa, as well as the performance of microbiology, genetics and molecular biology research over a 20-year period from 1980 to 2000. It was found that genetics and molecular biology publications have seen a steady decline while microbiology has steadily increased its share of world publications.

Although the quantity of the base is small, the relative impact factor suggests that the quality of publications in these disciplines is comparable to world output. They conclude that the lack of adequate output in these disciplines posed a threat to government policies and investment aimed at increasing biotechnology commercialisation.
A study was undertaken by Patra and Chand (2005) which resulted in the production of the paper “Biotechnology research profile of India”. The study explored the chronological growth of Indian biotechnology and examined the applicability of Bradford’s law of scattering and Lotka’s law for author productivity.

He Zhang and Teng (2005) undertook an analysis and produced the paper “Basic research in biochemistry and molecular biology in China: A bibliometric analysis” It was an analysis of research output during the period 1999-2002. The study found that the publication in biochemistry and molecular biology has increased 10% each year and the ratio of publication on these subjects in China to the global total is on the increase. This fast rate of increase is mainly due to the growth of publication of article in international journal written by Chinese authors. Further the number of Chinese paper published in higher influence journal has continuously increased although the average AIE of publication from China is lower than that of the world.

Hasan and Singh’s (2003) carried out a study and wrote an article entitled “Himachal Journal of Agricultural Research 1990-1999: A bibliometric study”. The assessment of contributions on Himachal Pradesh in agriculture and allied fields is based on publications indexed in AGRICOLA, AGRIS, CAB Abstracts and FSTA CD-ROM databases during 1990–1994. The result show that the universities (Viswavidyala) have produced good number of research publications every year but no uniform pattern of literature growth has been observed.

Sahu (2002) undertook the study “of Nation Mapping of Earth Science Research” and presents the mapping of Indian contributions in earth sciences culling the required data from the CD-ROM version of the georef database 1990, 1992, and 1994 that covered 1272, 784 and 367 Indian contributions respectively. The Indian
contributions in these three years accounted respectively 1.91, 1.56 and 1.13 percent of the world’s output. Over 99 percent of Indian contributions are in English. Around 70 percent of the Indian contributions are published in India, and the rest in countries like the Netherlands, the US, and the UK. The analysis shows that India is a major contributor in the fields of igneous and metamorphic petrology, applied geophysics, economic geology and geology of ore deposits, and engineering geology. India holds seventh to eleventh rank in the world’s literature output in these subjects.

After a thorough study Arunachalam and Balaji (2001) presented the paper “Fish science research in China: How does it compare with fish research in India? The study compares Fish Science Research done in India and China during the six years (1995-2000) China has published 2035 papers (roughly 4.5–5% of the world output) and India 2454. More than 95% of China’s papers are journal articles, compared to 82.8% of Indian papers. About 78% of China’s journal paper output has appeared in 143 domestic journals compared to 70% from India in 113 Indian journals. Less than one-eighth of the journal articles published by Chinese researchers are published in journals indexed in SCI, compared to 30% of journal articles by Indian researchers. Less than a dozen papers from each of these countries have appeared in journals which have an impact factor greater than 3.0. They have found that fish research institutes and fishery colleges are the major contributors of the Chinese research output in this area.

India’s contribution to research in agriculture and related fields in 1998 is assessed from an analysis of publications based on CAB Abstracts by Arunachalam and Umarani (2001). There were 11,855 publications from India, including 10,412 journal articles, from more than 1,280 institutions in 531 locations, spread over 30 states/union territories. CAB Abstracts has classified these papers into 21 major
research fields and 243 subfields. 'Plants of Economic Importance' (FF) is the leading area of research in India, followed by 'Animal science' (LL). The three subfields with the largest number of papers are: 'Pests, pathogens and biogenic diseases of plants', FF600 (1,301 papers), 'Plant breeding and genetics', FF020 (1,135 papers), and 'Plant production', FF100 (786 papers). In contrast, there were only 54 papers in 'Biotechnology' (WW).

Alexandre et al (2001) “Scientometric study on collaboration between India and Canada 1990-2001” is a report prepared by Department of Foreign Affairs, Canada International Trade and Industry, Canada. The results recorded in this study are as follows:

Annually on an average India produced during the period 1990-2001 a little over the thousand scientific papers whereas during the same period the annual production of such papers in Canada exceeded 24000. Indian scientists published most in the field of Physics and those belonging to Canada published most in chemical medicine. The total production of the fame in physics was above 25,000 and that of Canada in chemical medicine was nearly 92000. When indices of specialization are taken into consideration it is found that India’s index of specialization in Chemistry was 1.95 during 1990-2001, that of engineering and technology 1.47 and physics 1.35 (one is neutral and anything above this mark denotes specialization in one field). In the case of Canada it was 1.63 in biology and 1.61 in earth and space sciences.

From the data collected it has come to light that India has to go a long way. It’s scientific production is not yet published in journals of high calibre and cited highly by the scientists from other countries. In majority of the scientific fields, its average relative impact factor is below and its aggregate score 0.7. It strongest fields
of impact are physics (ARIF 0.9) mathematics (0.9) besides engineering and technology (0.9). On the other hand Canada’s research production is published in high calibre journals enjoying a very high degree of citation. It aggregate ARIF was 1.1, and in the field of chemistry the ARIF was 1.2 (during the period under discussion).

The writers have suggested that there could be favourable collaboration between India and Canada in the research fields of Chemistry and Physics. In these disciplines Canada has a very strong impact factor through a low specialization index. As such it could be very advantageous to both. The writers added that a complementary pattern would emerge if there is the required collaboration.

Using data from six databases Jayashree and Arunachalam (2000) made a study and produced an article entitled “Mapping fish research in India.” It was found that about 460 papers, roughly 5.5 percent of the world output, come from India every year, of which 82 percent are journal articles. Close to 70 percent of journal articles have appeared in 113 Indian journals. Less than a third of the journal articles are published in journals indexed in SCI. About 61 percent of publications are contributed by government laboratories and over 25 percent by academic institutions. Government laboratories publish most of their work in low impact and low visibility journals and academic institutions in journals of medium impact. However, even those papers appearing in better-rated journals are not cited well. Kochi, Chennai, Mumbai and Mangalore are the cities and Tamil Nadu and Kerala are the states contributing large number of papers.

research as indexed in BIOSIS biological abstracts 1992-1994. The study aims to map life sciences research in India as reflected by the journal literature, using standard techniques of scientometrics. It is a macroscopic study at the institutional level and does not analyse the data covering the volume of work published in India. This study shows that more than 54 per cent of Indian papers indexed in BIOSIS are published in Indian journals.

‘Other studies’ by Haigi (1994) is the paper which has yet another title “A bibliometric study on medicine Chinese traditional in Medline database.” This paper focused specifically on the subject of Chinese medicine. To describe a few, he examined the references of 343 articles listed under the MeSH topic Medicine-Chinese-traditional in the Medline database, covering the years 1974 to 1992. The data showed that most items originated from China and the United States. It was observed that Chinese and English were the preferred languages used and there was a high concentration of articles in a relatively small number of journal titles.

Bennell (1987) investigated and presented an article bearing the title "Crop science research in sub-Saharan Africa: A bibliometric overview”. It is the bibliometric analysis of publications output, during the period 1973-82 of sub Saharan African agriculture. The researcher concluded that there has been a perceptible decrease in the number of crop science publications by government researchers.

Arunachalam (1984) presented research article entitled “Eighty years of grape research in India” This study cover 80 years of Indian grape research publications. He found that India published 158 publications and the papers primary focused on the cultivation of grape crops.
2.4 Scientometric Study By Institutes

Scientists' affiliations with certain institutions are recorded on each published paper. This indicates the institutional support received by the scientists without which the research cannot be carried out. Hence, institutions are said to contribute to research when the institutions' names are indicated as scientists' affiliations. Frequencies of contributions are counted based on the number of times the institution's name is stated under each author's affiliation.

Sahu, et al (2011) analyzed the citation pattern and published the paper “Research publications of National Metallurgical Laboratory during the year 2001-2010 – A study on citation patterns” This paper analyzed the citation pattern of National Metallurgical Laboratory research publications. The study found that the highest number of 120 papers was published by the laboratory in the year 2010, out of which 28 papers received 62 citations. The average number of publications per year was 88.1. High citations received were in the areas of materials science, metallurgical engineering, nanoscience and nanotechnology and environmental engineering over the last decades as observed during the period 2001-2010. The h-index of the last decade was 25.

Sarkel Juran Krishna Choudhury and Nitai Ray (2010) undertook the study of the contribution of BCK University and published an article based on that study under the title “Contribution of Bidhan Chandra Krishi Viswavidyalaya (BCKU) to agricultural research: A bibliometric study” He published totally 2807 articles during 1993-2007. The researchers found that the authorship pattern shows the trends towards collaborative research.
Hazarika et al (2010) examine the research papers written by Nayana Nanda Borthakur and wrote the article “Scientometric portrait of Nayana Nanda Borthakur: a biometeorologis.” They studied Quantitative documentation of the research papers of Nayana Nanda Borthakur published in peer-reviewed journals during 1963-2005. They found a total of 106 papers to his credit. Collaborative authorship pattern is found to be in the team size of 2; 5. Twenty five are single authored papers, 33 two authored, 27 three authored, 17 four authored and four papers are five authored. Highest number of paper was published in International Journal of Biometeorology (15). The core area of research was related to evaporation, air ions, electro hydrodynamics (EHD), microwave irradiation, beta-ray gauge technique among others.

Rekha Rani Varghese (2009) undertook an analysis which resulted in the writing of the article entitled “Productivity of scientists of Rajiv Gandhi Centre for Biotechnology (RGCB): an analysis”. It was an analysis of 632 publications of RGCB scientists during 1995-2006. The results show that the publications of RGCB scientists include journal articles, conference papers, patents, book chapters and theses. The year 2005-2006 with 112 articles (25.87 %) published is the most productive year in the case of journal articles. The productivity of the scientists of RGCB shows substantial growth both quantitatively and qualitatively with the development of the institution.

Kadeamani (2009) et al attempt an analytical study and published a paper entitled “Research contributions in Chemistry at the University of Burdwan: An analytical study”. The study examined the scientometric dimension of productivity of scientist of the chemistry division of Bhabha Atomic Research Centre (BHRC) It was found that the highest number of publications in a year was 98 and 104 produced in 1989 and 1996 respectively. The average number of publications per year was 57.76.
The highest collaboration coefficient 1.0 was in 1977 and 1999. The author with most prolific publications was Mittal J.P (204). The core journals preferred for publishing with high number of publications was: Indian Journal of Chemistry. Publication concentration was 28.57% and publication density was 5.48. Top ranking journal with the largest number of article was Indian Journal of Chemistry. The number of publications was as follows: from the UK (471), India (326), the Netherlands (302), the USA (277) and Switzerland (104).

Bandyopadhyay and Nandi (2009) undertook an analytical study and prepared article entitled “Research contribution in chemistry at the University of Burdwan An analytical study”. The analyzed one hundred and forty one theses and 979 articles submitted to Chemistry Department of the University of Burdwan during 1960-2000. It was found that the highest number of theses (30) was submitted during 1986-1990 and 1991-1995. Highest number of papers (283) was published during 1991-1995. Maximum number of theses (58) was submitted in inorganic chemistry and that Rabindra Lal Dutta supervised highest number of theses (17). The most prolific author was A.K. Das with 82 papers. About fifty three percent of the papers (522) have been published in Indian journals. For the publications of other research papers (149) the preferred countries were Netherlands (15.32%), the UK (11.64%) and the USA (10.01%).

Aminpour and Heydari (2009) undertook the study of scientific production and prepare the article “Scientific Production of Isfahan University of medical Sciences”. The study discussed Scientific Production of Isfahan University of Medical Sciences based on approved projects. The findings showed 100% increase in published indexed and non-indexed journal articles, a growth of 99% in approved research projects and 94% in congress proceedings in 2006 compared to those in 2006.
2005. The study indicated a significant growth in research performance of Isfahan University of Medical Sciences throughout 2006.

Sharma (2009) published a bibliometric study entitled “Research publication trend among scientists of Central Potato Research Institute: A bibliometric study” The study shows that majority of the scientists preferred to publish research papers in joint authorship (82.67%). Further there had been no uniform pattern of literature growth.

Jancy James et al (2008) undertook a bibliometric analysis of doctoral theses and presented a research paper. That article carried the title “Doctoral Research at Mahatma Gandhi University 1983-2008: A Bibliometric Analysis”. The study analyses the doctoral research work carried by scholars in MG University during the first twenty-five years of its existence (1983 to 2008). The study found that this University had produced doctorates in highly relevant and emerging areas of science like biotechnology, genetic engineering, biodiversity studies and environmental conservation and that a few guides supervised research in very specific areas and the research by them as well as by their students form the highly cited Indian works worldwide, such as in Polymer.

The rise and fall in the curve on number of scholars enrolling for research at a time is found related to the implementation of UGC Schemes and their periodical revisions. Research in science and arts subjects reveals slow and steady growth with very little fluctuation in scientific research, and steep fluctuations in arts and social sciences. Literary studies, Chemical Science, Polymer and Rubber besides Cancer are found to be the strong areas of MG University research during the last two and a half decades.
Bhat (1995) studied research trends at the National Institute of Occupational Health (NIOH) based on the research projects reported in the annual reports of the institute over a period of 25 years from 1975 to 1999. The article was given the title “Research trends in a premier institute based on annual reports”. Out of a total of 380 projects carried out during this period by the institute, 184 projects (48.4%) were epidemiological studies, 75 projects (19.7%) focused on environmental studies and 121 (31.9%) were on experimental studies.

The paper Presented by Singh (Yogendra) et al (2005) bearing the title "Research Contributions and Impact of Research of Indian Institute of Technology, Roorkee" suggest a methodology for studying the quantitative profile of a research and teaching institute, with a view to getting an idea about its major research contributions, performance and impact in different fields of S and T. A number of quantitative and qualitative indicators have been used for studying the relative performance of the institute across various subject fields. The writer have come to the conclusion that the three subjects, namely mathematics, biology and clinical medicine, despite contributing smaller number of papers, secured first three ranks in terms of average normalized impact per paper. They have also done fairly well in terms of percentage of collaborative papers, but fared badly in terms of contributing to high quality papers, with the exception of clinical medicine. These three fields have performed the best in terms of publication effectiveness index.

Kademani et al (2005) have analysed quantitatively 475 papers published by the Bio-Organic Division of Bhabha Atomic Research Centre during 1972–2002 in various domains like Synthesis (202), Bioorganic Chemistry (100), Biotechnology (70), Natural Products (53), Waste Management (30), Supra-molecular Chemistry (18) and Organic Spectroscopy (2).
The highest number of publications in a year was 38 in 2001. The average number of publications per year worked to 15.3 and the highest collaboration coefficient 1.0 was found in the years 1972, 1976-1977, 1980-1985, 1987, 1989-1990 and 1993. The most prolific author was Banerji (125). The core journals preferred by the scientists to publish their papers include Indian Journal of Chemistry-B (56).

**Surandra Kumar and Kumar (2004)** carried out the productivity study of the scientist of National Research Centre for Soyabean. The study was published under the head “Productometric study of scientists of ICAR’s National Research Centre for Soyabean (NRCS)”

**Sevukan et al (2003)** published an article on “Research output of faculties of plant sciences in central universities of India: A bibliometric study”. The study analyses research output in plant sciences of the faculties in central universities of India. It has been analysed bibliometrically using web of science database during 1997-2006. They have found that

i) the plant sciences literature has grown steadily during the study period except during 1997 and 2002;

ii) articles play an important role as a predominant source of plant sciences literature;

iii) the plant sciences research in central universities of India is fairly collaborative; and

iv) the productivity of authors fits Lotka’s distribution while scattering of journal articles does not fit into Bradford’s distribution.

“Scientometric dimensions of technical reports from Bhabha Atomic Research Centre” by **Swarna et al (2002)** is the study analysis of BARC Technical Report during 1990-99. The study reveals that Bhabha Atomic Research Centre (BARC)
published 554 technical article during 1990-99 under the following categories: External (373) and Internal (181), Engineering and technology generated (207) technical reports followed by chemistry, materials and earth sciences (129), while their interdisciplinary interactions resulted in 31 technical reports. Forty two technical reports on life and Environmental Sciences followed by Physics (16) aspects of nuclear and non-nuclear energy (6) Isotopes, isotope and radiation applications (4), and similar reports. On subjects outside the scope of nuclear science and technology 69 articles were published.

"Koganuramath et al (2002) under took a study and produced the paper entitled “Bibliometric dimension of innovation communication productivity of Tata Institute of Social Sciences”. It was found, that 92.46 percent (613 papers) of papers were single authored followed by 6.33 percent (42 papers) two authored papers. Maximum collaboration coefficient (0.13) was found during 1996-1997. Most prolific authors were: Murli Desai, Sarthy Acharya, Lakshmi Lingam, I.U.B. Reddy, Kailash, Shalini Bharat, and Chhaya Datar. The core journals that published Tata Institute of Social Sciences scientists’ papers were: Indian Journal of Social Work (98), Economic and Political Weekly (26).

Citations from twenty doctoral dissertations on plant pathology submitted during the period 1980-93 were collected by Lal and Panda (1996). They drew up ranked list of one hundred most frequently cited journals which accounted for 73.01 percent of the total citations.

Yadav (1985) probed into the communication trend among the potato scientist and found that research journals are the main instrument of communication among them. The study was published as an article entitled “Research Communications Trend of Indian Potato Scientists".
2.5 Scientometric Study By Scientists

The individual paper of a scientist is not the final form of the consensus; it is one among the bricks from which the whole edifice is to be built. Not only do scientists seek to publish their findings, they also seek to gain recognition from their peers, seen in the form of citations to the published papers.

Sociologists of science stated that "the reward system in science comprises two halves: the first half is the scientists' contribution, the second half is the appreciation shown by other scientists in using and acknowledging that contribution." (Gaston 1978) Many researchers have compared citation studies with perception studies of the quality of scientific papers and found a positive correlation between citation rates and perception levels. Papers having high citation rates have been found to be highly rated in studies using interviews and/or questionnaires (for example, Lawani 1980, Zuckerman 1987).

Research is an important aspect for the development of a nation. The research output of a nation is a yardstick to measure its socio-economic and educational status. There are a number of ways to measure the quantity and quality of the research output of the country and even the contributions of an individual. (Gangan and Gupta 2011) In the light of above assertions the following reviews gain importance:

Kalyane and Samanta (2010) conducted informetric analysis on published paper by K. Ramiah, an agriculture scientist of India. This study written under the title "Informetrics of K.Ramiah" throws light on the history of science, scientific development, interaction within a research group and organisation of research systems. While some contributions are based on solo research, many represent multiple authorship in the subjects of Biophysics and Crystallography.
Kademani et al (2009) undertook a study based on INS database for the period from 1970-2008. The article was written under the head “A study of Bhaba Scattering: A scientometric View”. The study yielded the following results: the average publication per year (during the period under study) was 32.62, and the highest number of papers-66-was published during the year 1987-1988. Further it was found that 42 countries were involved in the research in the field with Germany being the top producing country.

Parvathamma et al (2008) undertook bibliometric study of T.M. Aminabhavi’s research publications. The findings indicate that he published 521 research papers and there are three patents to his credit. Rudzinski is his most collaborator author, and Journal of Applied Polymer Science, published in the USA has been the most preferred journal for publishing his research articles (102 research articles). Further it was found that 70.81 percent of his research articles were published in the journals originating from the USA (326 articles - 59.11%) and 61 articles- (11.70%). were published in Indian journals.

Savanur et al (2007) undertook an examination of the research production of Prof S. Ramaseshan (Prof SR) and presented the article under the title “Scientometric Portrait of Prof. SR” The period covered was between 1994 and 2000. It was found that he published 178 papers during these seven years. He wrote 147 papers in collaboration with other scientist and the remaining articles individually. Further it was noted that Prof SR was interested in the following fields of study: crystallography, magnetic-optics, optics and solid state (physics).

Sangam, and Savanur (2006) carried out a bibliometric study about Rudraiah. The paper analysed the published papers written by Dr. Rudraiah. He published 271 papers during 1962-2004. With the collaboration of M. Venkatachalappa, he produced
31 papers. Dr Rudraiah published most of his research article in the Indian Journal Pure and Applied Mathematics.

**Susanta Koley and Sen (2006)** wrote an article entitled “A biobliometric study on Prof. B. N. Koley, an eminent physiologist "The article examined the research activity of Prof. B N Koley. This study showed that Prof. B N Koley published 251 research articles during 1958-2001. The study has also found out the author’s productivity and spectrum of research activity through analysis of the title keywords, and productivity of Koley's research group. Finally, it shows that the data set does not follow Bradford distribution.

The paper written collectively by **Angadi et al (2006)** entitled" Nobel Laureate Anthony J Leggett: A scientometric portrait” attempts to analyse the publication productivity of Anthony J. Leggett, the 2003 Nobel Prize winner in physics. His productivity coefficient was found to be 0.60, published forty two papers. His publication density was 3.02 and publication concentration was 3.59.

**Sangam et al (2006)** produced a paper on Prof Ranachandran under the title “Communication and collaborative research pattern of Professor Ramachandran a scientometric portrait” During the period 1942 and 1990 the professor published 304 articles. His collaboration coefficient is 8.86 with having collaborated with Sasisekaran the maximum number of times. Most of his publications were printed in Proceeding of the Indian Academy of Science. Many were published in ACTA, Crystolographica, Current Science, Nature and Biopolymers.

Similarly **Munnolli and Kalyane, (2003)** studied R. G. Rastogi’s publication productivity. He has published 312 papers. His highest productivity was during 1978 with 28 papers published in Indian Journal of Radio and Space Physics, (India) and in Journal of Atomic and Terrestrial Physics, (UK) 59 each.
Sen and Karanjai, (2003) evaluated. Dr. Biman Bagchi research publications and presented the article “Dr. Biman Bagchi: A bibliometric portrait” It was found that he published 226 papers, and most of the papers were published during 1999-2002. He published the highest number of papers (91) in Journal of Chemistry and Physics.

Dr. Biman Bagchi published 30 papers independently, and the remaining papers in collaboration. He mostly collaborated with Chandra. This paper presents the concrete example of different aspects of research paper writings such as growth, peaking and declining of citation rate. A few new terms such as citation gain, citation loss, gaining citation rate and losing citation rate have been introduced and described in this article.

A similar study was conducted by Vijay Kumar et al (2002) on the publications of Ahmed Hassan Zewail, Nobel laureate in Chemistry, who had collaborated with one or two colleagues and published 246 papers during 1976-1994.

Kalyane et al (2001) undertook the scientometric analysis of 91 papers by Ranjit Kumar Mitra and wrote the article “Scientometric portrait of Ranjit Kumar Mitra” It was found that between 1965 and 2001 he published the highest number of papers on Biochemical Genetics (30), and productivity coefficient during that period was 59. The over all collaboration was 0.95 whereas publication contribution was 36, publication density 1.25 and average Bradford Multiplier 1.5.

Kademani et al (2000) analysed the research publication of Vikram Sarabai, the famous Indian scientist and produced the paper “Scientometric Portrait of Vikram Ambalal Sarabhai: A Citation Analysis” The scientist is involved in research area such as Astronomy, Physics, Nuclear Physics, Geology, Geophysics, General
Science and extra disciplinary subject like Veterinary sciences , computer and Telecommunication.

**Kalyane and Sen (1998)** produced an analytic article “Scientometric portrait of C. R. Bhatia, an Indian geneticist and plant breeder (1998)” on the famous scientist. This study analysed the research publications of CR Bhatia. The later produced and published a total number of 124 papers during the period 1961-94.

This analysis yielded the following results: productivity coefficient on 0.7; publications 38 single author papers; 13 two author papers ;56 three-author papers and 35 highest number of papers mutation research and mutation breedings.

**Kademani, and Kalyane (1998)** undertook an analytical study and presented “Scientometric portrait of R. Chidambaram: A publication productivity analysis” The study is based on citation. The result shows that the total number of citations received for the publication of Chidambaram upto 1972 has been1302. The average number of citations per year has been 37.2 and the average number of citations per paper is 8.24. The writers concluded that Dr. Chidambaram was a model scientist.

A study for analyzing the publications of yoga scientist MN Bhole was undertaken by **Kulkrahi (1997)** and was printed under the title “Bibliometric portrait of the scientist working on Yoga” He contributed 147 papers during 1965-1995. These reveal that about 60% of his contributions are based on collaborative research and do not confine to one type of research.

Another study by **Kalyane and Sen (1996)** “Scientometric portrait of Nobel laureate Pierre-Gilles de Gennes”, made on the contributions published by Nobel laureate pierre-Gilles de Gennes during 1956-1995 revealed that scattering of publications did not follow Bradford's Law but assumptions about author productivity was found to be more or less correct. He has done interesting research pertaining to
areas in magnetism, superconductors, hydrodynamics, polymers, liquid crystals, gels, and glue. The honours and awards received by scientists tend to attract more collaborators and increase the productivity of his contributions.

Kalyane (1994) undertook a study of M. S. Swaminathan’s contribution to biological sciences. The article was published under the title “Scientometric portrait of M. S. Swaminathan” which provided commendable scientometric data.

2.6 Inference

- From the above it becomes manifest that the research scholar on bibliometric, scientometric, mapping of literature, quantitative analysis and informatics study use web of science, scopus database and a few studies use Inspec, LISA, Medline, Pubmed database.
- The Bibliometric, scientometric technique assessment are used all over the world.
- A substantial number of Indian researchers are involved in bibliometric, scientometrics Informatics studies.
- Biblioiometric, scientometric articles appear not only in library and information science journal, but also in other subject journals. This is evident from the study of inter disciplinary research and world level assessment tools.
- General objective of most of the studies is to find growth of literature as also to find core journal and compare country wise publications
- The studies are mostly based on data drawn from database, individual journals, individual country’s research publication in particular field of knowledge, individual subject’s world output individual author’s publications and the like.
This indicated that scientometric research contributions put in black and white were highly scattered. Therefore the investigator has chosen scientometric as the subject field and analysed the agriculture literature research covered in the web of science database.

2.7 Conclusion

Based on the literature review it is found that proposed study using title “Scientometric analysis of Agriculture literature: Global Perspective” could prove a fruitful attempt.

The review of the literature presented above indicates that there is good scope for an in depth study in the above. A close perusal of the above review brings to light the fact that there are many gaps and chasms which have to be bridged to make this scientometric analysis more coherent and meaningful. A painstaking scientometric analysis of agriculture literature would be quite useful to all those who are in one way or other connected with it-whether a layman or an agricultural scientist.