CHAPTER II
REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

Review of the literature is a significant part of any research study. The investigator acquires information about what has been done in a field of study, to arrive at a fruitful conclusion. The review presents a vivid picture about previous research in the area which the study intends. A familiarity with available literature in the area of research is also required by the investigator for making new grounds besides the proper designing of the study. Review of related studies further avoids duplication of work that has already been done in that area. It also helps the investigator to study the different aspects of the problem. It enables the investigator to identify the research gaps or the unexplored areas if any, in order to create new grounds for research. It makes a brief review of previous studies on the problem and significant writings related to the topic under study. An attempt has made in this chapter to review some related literature on seismic studies.

The 83 reviews of related literature analysed by the researcher are presented under the following four broad groups.

- Studies on various Scientific Subjects
- Studies on Individual Journals, Institutions and authors of a particular country
- Studies on Arts, Humanities and Social Science Subjects and
- Studies on Earthquakes

2.2 STUDIES ON VARIOUS SCIENTIFIC SUBJECTS

Nirmala and Shivraj (2016) analysed the research output on biosensor literature in the world during 1979–2015. A total of 46719 records were downloaded from the Scopus database. The biosensor literature in the World has been started in the year 1979 with one record and gradually raised to 4117 records in the year 2014 and it has slightly come down to 3992 in the year 2015. United Stated has contributed the highest number of
publications on biosensor research which published 11094 (20.30%) documents followed by China with 8585 documents (15.71%). Most of the documents of research on biosensor literature are research articles which occupies 73.50% of total output. ‘Nanjing University’ has published the highest number of documents (520 documents) on Biosensor research followed by ‘Chinese Academy of Sciences’ with 470 documents (1.98%). The author Wang has published the highest number of publications (194) on biosensor and he has published a total of 944 publications with 27006 citations. The journal ‘Analytica Chimica Acta’ has got 73 citations per document during 2014 which is the highest average citation among all other biosensor literature journals during 2013 and 2014.

Husain and Mushtaq (2015) analysed 17,266 publication records on different aspects of climate change published during 2009-2013. The highest (4788) publications were produced in the year 2013 and the lowest (2238) was in the year 2009. The highest number of publications was produced by USA followed by England. Thuiller, W followed by Smith, P. were the most prolific authors in the field of climate change. The journal articles were the most widely used document forms followed by reviews. The prolific journals were ‘Climatic change’ and ‘Global change biology’. The study also assessed the citation patterns including the country's citations, citations of affiliated institutes, and average, self and unique citations received of select years.

Vivekanandhan, Sivasamy and Narayanan (2015) presented the research trends in authorship pattern and the degree of collaboration of pollution control research output in India for the period of 2003–2014 from Scopus database. A total number of 77431 publications are published in worldwide and India is in the fourth place with 3368 research publications. The average degree of collaboration is 0.90.

Abu and Balasubramani (2015) analyzed the growth of research publications in the field of Nanosenors. A total of 1925 records were downloaded from Web of science database. The findings revealed that ‘Chinese Academy of Sciences’ and ‘University of Michigan’ were the major producers in Nanasensors research output. The top ten journals
produced more than one by fourth of the total research output and in the contribution of
countries, USA dominated the field with 759 records.

**Elango and Rajendran (2015)** compared country output and citation impact as
well as assessed the level of interdisciplinary in the field of *tribology research* during the
period 1998-2012, based on the SCOPUS database. Macro-level scientometric indicators
such as growth rate, share of international collaborative papers, citation per paper, share of
un-cited papers, and publication efficiency index were employed. Further, the Simpson
Index of Diversity was used to measure the level of interdisciplinary. The performance of
top countries contributing more than 1000 papers during the study period was discussed.
Contributions and share of continents and countries by income groups were examined.
Further research contributions and citation impact of selected country groups were
analyzed. This study reveals that high levels of interdisciplinary exist in tribology research.
Asia outperforms the other world regions and China contributes most of the papers (25%),
while the United States receives most of the citations (22%).

**Li and Zhao (2015)** analysed 113,468 publications on ‘environmental
assessment (EA)’ from the past 20 years, The study used a bibliometric analysis of the
literature in terms of trends of growth, subject categories and journals, international
collaboration, geographic distribution of publications, and scientific research issues. A
frequently used keywords analysis found that the priority in assessment would gradually
change from project Environmental Impact Assessment (EIA) to Strategic Environmental
Assessment (SEA). Decision-theoretic approaches (i.e., environmental indicator selection,
life cycle assessment, etc.), along with new technologies and methods (i.e., the geographic
information system and modeling) have been widely applied in the EA research field over
the past 20 years. Hot spots such as “biodiversity” and “climate change” have been
emphasized in current EA research, a trend that will likely continue in the future.

**Okhovati, Zare, Zare, Bazrafshan and Bazrafshan (2015)** analyzed the trends in
global ‘assisted reproductive technologies’ research output from MEDLINE database for
USA, UK, France, Germany, Canada, Italy, Japan (G7 countries), Brazil, Russia, India,
China (BRIC countries), Egypt, Turkey, Israel and Iran. The absolute number of publications for each country from 1998-2014 ranged from 75-17453 with a median of 2024. Among the research domains of assistive reproductive technologies, Cryopreservation and IVF were the emerging research subjects. 96739 articles were published on ART during the study period. Semantic word mapping technique was implemented to identify the subject areas using the VOS viewer software. G7 countries were the major contributors of ART research in the world. The research productivity registered by USA was 21.82%, UK 9.78%, Italy 7.98%, Turkey 5.19% and China was 4.33% during the study period.

Arya (2015) undertook a bibliometric study on research output on Plant Pathology Research during 2008-2012. The data used for the study was taken from CeRA (Consortium for e-Resources in Agriculture) database. Totally 4392 journal articles published in different journals were taken for the study. The study focused on the number of articles by year, authorship patterns, degrees of collaboration, contribution by institution, ranking of leading contributors, geographical distribution of articles at the national and the international level, subject growth of literature in plant pathology, and journal productivity patterns in plant pathological research. The findings revealed that: out of 4,392 articles, single authors contributed 3.26% of the articles while 95.99% of the articles showed multiple authorships. The average degree of collaboration is found to be 0.97. Universities contributed the maximum number of 3,383 articles. University of California got first rank with 222 publications. In India, Uttar Pradesh contributed the highest number of articles (143). The United States of America published the maximum number of 1,980 articles at the international level.

Thavamani (2015) assessed the literary output in Leptospirosis productivity for the period 2006-2013 collecting data from MEDLINE database. The findings reveal that the year wise distributions of Leptospirosis records are increasing year after year except in 2008, 2009 and 2011. 88.76% articles are of English language followed by Spanish and French languages. USA has contributed the highest number of records in the study period.
Next major contribution belongs to England, Netherlands and India. India has the 4\textsuperscript{th} position among the countries. 42.77\% (5033) of all the cited records were “journal articles”, 35.93\% (4228) “Research Support, Non-U.S. Government”, 8.92\% (1050) “Review”, 5.89\% (693) “letter”, 3.03\% (357) “Research Support etc. Relative Growth Rate (RGR) decreased from 2007 (0.75) to 2013 (0.17) in the span of 8 years and Doubling Time (DT) increased from 0.92 in the year 2007 to 4.00 in the year 2013. The Activity Index (AI) for India was peak in 2006 (234.04).

\textbf{Vellaichamy and Jeyshankar (2014)} made a quantitative study of research output on Anemia disease. The data used for the study were retrieved from Scopus online multidisciplinary database for the period 1993–2013. The study focused on authorship pattern, degree of collaboration, most productive authors, subject pattern, major collaborative partners in India, most productive journals, active institutions and highly cited papers. The study revealed that 5085 papers were published during the period. The highest number of papers (739) is published in the year 2013 but it received 178 citations only. The minimum number (47) of papers is published in the year of 1996, but they have received 3245 citations. Findings indicate that lowest number (0.56\%) of citations received in the year 2013.

\textbf{Maharana, Das and Sahu (2014)} undertook a study on bibliometric analysis of all Indian tuberculosis publications over the past 10 years. The data used for the study were retrieved from the Scopus database. The study covers totally 7945 documents. 6083 were research articles. The number of documents in 2012 was nearly thrice than that in 2004. The research productivity of Indian researchers’ on TB research shows their awareness and cautiousness. The study insisted that nationwide involvement of government and private medical colleges, research canters and universities will yield better research output and helps to check and prevent TB.

\textbf{Subramanian (2014)} undertook a 5-years (2008-2012) bibliometrics study in Medicinal and Aromatic Plants (MAP) with a special focus on the authorship from India. The data is retrieved from Web of Science. Indian authors are found to have performed
better in their global citation score. A sum of 617 publications was found to have been published by a total of 1884 authors from across the globe. In total, 697 institutions have participated in the global contribution to the MAP research literature. Though the overall performance of India as a nation is impressive with good number of publications, the performance of individual institutions could have been better.

Balasubramani, Gopalakrishnan and Gnanasekaran (2014) identified the growth of research output on Genetic Engineering. The data were downloaded from the multi discipline citation database ‘Scopus’ and there were 165984 records contributed worldwide over a period of 40 years from 1974-2013. Among them, 59877 (36.07%) publications were contributed by USA and it holds first place. India holds 8th place with 5354 (3.23%) publications.

Bandboni, Ramezani and Langeroudi (2014) compared the scientific production in the field of ‘reproductive medicine’ in Iran and Middle East Countries during 1996-2012 using data collected from SCOPUS database. Iran (660 articles) was in 11th rank in global share up to 2012 and was ranked 1st among the Middle East countries. H-index of the scientific literature in the field of reproductive medicine was 14 between the Middle East Countries whereas it was 4 for Iran. There were 24 journals in the field of reproductive medicine which are indexed around the world and out of them 4 belong to Iran. Iranian h-index indicated that there is a progress in the research activities and its influence of the scientific production in this field.

Niu et al. (2014) conducted a bibliometric analysis of global trends in sediment-related research in earth science during 1992–2011. The study showed that multidisciplinary geosciences and environmental sciences were the two major categories, and ‘Environmental Science and Technology’ was the most active journal. Damste JSS and Schouten S were the two most prolific authors with the most high-quality articles and the greatest geographic influences. The major spatial clusters of authors overlapped quite well with regions with high economic growth in the USA, Western Europe, and Eastern Asia. The USA was the largest contributor in global sediment research with the most
independent and collaborative papers, and the dominance of the USA was also confirmed in the national collaboration network. National academic output was positively associated with its economic capability. ‘The Chinese Academy of Sciences’, ‘the US Geological Survey’ and ‘the Russian Academy of Sciences’ were the three major contributing institutions.

**Tripathi and Garg (2014)** analyzed scientific output of India in the discipline of *crop sciences* as reflected by the coverage of scientific output in three different databases i.e SCOPUS, CABI Abstracts and ISA during 2008 - 2010. The analysis indicated that highest number of papers was published on rice and wheat crop. The authorship pattern reveals that co-authored papers accounted for 72% of total output.

**Kanagarasu (2014)** analyzed the growth and development of *wind energy research productivity* in India in terms of publication output as reflected in Web of Science (WoS) for the period 1993–2012. It included 6224 publications from India, including 2799 articles, 2639 Proceedings Paper, 339 reviews, and etc., from 3154 institutions. About 9.4 % of publications are contributed by ‘Indian Institute of Technology’, Kanpur followed by ‘Bhabha Atomic Research Centre’, Bombay (7.27 %). All the papers published by Indian researchers have appeared in journals with impact factors between 0.20 and 4.14. About 24.24 % of authors contributed single articles. The growth rate of publications varied from 0.50 to 14.7 % per year. The annual growth rate was highest in the year 2012 at 14.7 %. The study reveals that the output of wind energy research in India has gradually increased over the years.

**Ranganathan (2014)** examined *Oceanography Research in India* as revealed by the scholarly publication indexed in Aquatic Science and Fisheries Abstract (ASFA) data base for a period of fifteen years from 2008 to 2013. The study reveals that, most of the researchers preferred to publish their research results in journals; as such 61.78% of articles were published in journals, more numbers of articles were published in the year 2013. It is observed that author productivity is not in agreement with Lotka's law, but productivity distribution data partially fits the law when the value of Chi-square is 199.01.
Bhardwaj (2013) detailed a quantitative analysis on celiac disease. The data used for the study were retrieved from Scopus for the period 2001-2012. The results indicate that 14356 papers were published during the period. The highest number of papers (1604) was produced in the year 2011. USA is the most productive country in celiac disease research which has 19.68 percent share of total world publications. The USA publications have received 27973 citations with 9.79 average citations per publication. The significant area of celiac disease research remains the medicine which has 86.82 percent share of total research output. UniversitádegliStudi di Napoli Federico II, Italy is identified as the most productive institution which has contributed highest number of publications (231 papers; 6800 citations; h-index value 41). Markku Maki from University Hospital of Tampere, Finland is the most productive author who has contributed 157 publications, and received (5250) citations.

Shao, Yu, Bo and Duan (2013) analyzed the oncology research literature published during 2001-2010 qualitatively and quantitatively. Documents published in 30 representative oncology journals were retrieved from the Web of Science (2001-2010). Knowledge domain visualization, co-citation analysis and social network analysis methods were employed. It identified the primary research centres, including the top 20 institutions and countries, the 4 major oncology research fronts and 36 most collaborative academic communities. Multiple myeloma, angiogenesis and acute lymphocytic leukemia were found to be the focuses of collaborative research in oncology. Over the past 10 years, America had led oncology research, while China was the sole developing country to be ranked in the top 10.

Goel, Maurya and Desai (2013) explored the research and development indicators in solar energy research in India. It was observed that USA has been the major producer of solar photovoltaics followed by India. In terms of publications of solar energy output, India on per capita basis continues to be approximately one fourth that of the world and was one among the five leading countries. Basic research was mainly conducted by Universities and Academic institutions while applied research was carried out by R & D
centres and Labs. There was a strong correlation between the R & D input and technological growth. It is suggested to have international collaboration to improve the research performance.

Sooryamoorthy (2013) investigated the scientific research publications in the field of natural science in South Africa. The study found that the majority of authors were from universities while the research institutes were the 2nd major contributor in terms of publications. Like South African researchers in the natural sciences, foreign partners originated mostly from universities and research institutes. The only difference between South African authors and their foreign partners affiliated to universities was that South African researchers had partners from government and industry, but, for foreign partners, government and industry partnerships were relatively negligible. Collaboration with foreign scientists was remarkable in the natural sciences research in South Africa. Introduced in 1987, the funding system for universities made an impact on research and research output in South Africa. Funding agencies that support research opt for inter-regional or inter-national collaborative projects rather than individual projects located in a single institution or in a single country.

Cao, Zhou and Wang (2013) carried out a bibliometric analysis of global laparoscopy research trends during 1997–2011. The study evaluated the global scientific output of laparoscopy research, and tries to find an alternative statistical approach to quantitatively and qualitatively assess the current global research trend on laparoscopy. Data were based on the Science Citation Index Expanded (SCIE), from the Institute of Scientific Information Web of Science database. Articles referring to laparoscopy during 1997–2011 were concentrated on the analysis by scientific output characters, international collaboration, and the frequency of author keywords used. Globally, 59,264 papers were published during the 15-year study period, including 15 document types. Among them, there were 40,318 articles, to which a two-phase model was applied to simulate the high correlation between cumulative number of articles and the year. International collaborative publications were more prevalent in recent years, and were more powerful due to the
sharing of ideas and workloads. Japan, Sweden, Poland, Canada, the UK, India, France and Spain benefit a lot from the international cooperation.

**Zhuang, Liu, Nguyen, He and Hong (2013)** carried out a bibliometric study on **Global remote sensing research** trends during 1991-2010. The study found that ‘International Journal of Remote Sensing’ was the top active journal. All authors were mainly concentrated in North America, Western Europe, and East Asia. Jackson T J from USDA ARS was the most productive author, Coops N C from ‘University of British Columbia’ had more high-quality articles, and Running S W from ‘University of Montana’ carried the greatest geographical influence. The USA was the largest contributor in global remote sensing research with the most single-country and internationally collaborative articles, and the NASA was the most powerful research institute. The international cooperation of remote sensing research increased distinctly. Co-word analysis found the common remote sensing platform and sensors, revealed the widespread adoption of major technologies, and demonstrated keen interest in land cover/land use, vegetation, and climate change.

**Blank et al. (2013)** conducted a bibliometric study on directions in **green roof research**. The study found that the number of publications in this field increased in the last two decades at very similar pace to other pre-established academic disciplines. The study found that papers on green roofs were classified into 32 research areas. There was very little change in the frequency of most research areas through time. The percentages of plant sciences, forestry, marine and freshwater biology and biodiversity conservation of the total research areas classifications used each year increased significantly with time, while architecture decreased significantly with time signifying an increased interest in environmental issues and less focus on architectural issues. The distribution of publications between countries has been skewed, with the USA and the EU conducting 66% of the research, and thus allocation of research effort was focused in those continents and predominantly in temperate ecosystems. However, there has been a sharp increase in the number of countries that conduct green roof research. The study provides a suite of
indicators that can be combined to give a useful picture of the development of green roof research and identifies the challenges which lie ahead for this novel research area.

**Sagar, Kademani and Bhanumurthy (2013)** studied the scientometric mapping of publications on **dark energy** during 1999-2011. The study reveals that Europe was the most productive continent with 3723 (41.15%) publications and 126,747 (39.88%) citations followed by Asia with 2614 (28.89%) publications and 63267 (19.90%) citations. Publications from North America received the highest average number of citations followed by Australia, Europe, South America, Africa and Asia. Canada had the highest PEI (346.51%) followed by Chile with 315.54%. The relatively higher CAI of England, Germany, Italy, Japan and USA indicated that scientists in those countries prefer to work in larger groups.

**Romo-Fernandez, Guerrero-Bote and Moya-Anegon (2013)** made an attempt to a study on Co-word based thematic analysis of **renewable energy** (1990–2010). The study indicates about the analysis of keywords which was aimed at revealing publication patterns in the field of renewable energy, including the temporal evolution of its different research lines over the last two decades. The records of the sample were first retrieved, then keywords were processed the to resolve their obvious problems of synonymy and to limit the study to those most used. The final results showed a clear increase in scientific production related to alternative energies, and a structure corresponding to five major clusters which, at a finer level of resolution, were decomposed into 22. The study analyzed the structure of the clusters and their temporal evolution, paying particular attention to uncovering the bursty periods of the different lines of research.

**Kumar (2013)** examined **human computer interaction** (HCI) research during 1987-2011. India is at 16th position in the world in HCI research publications with 2656 papers by 3691 Indian authors from 693 institutions of India. The Transformative activity index (TAI) suggests that India’s research activity in the field of HCI is improved greatly in the last 5 years. Although highest number papers are contributed by ‘Indian Statistical Institute’, about half of publications are contributed by engineering colleges. All the papers
published by Indian researchers have appeared in journals with impact factors between 0.090 and 5.211 with an average impact factor of 1.455. Indian authors preferred to publish in journals originated from United Kingdom, the Netherlands, USA and Germany. Citation analysis for Indian publications gives 9.8 citations/paper.

Eghbal, Ardakani and Asgary (2012) did a comparative study on endodontic articles published in Iran with the neighbouring countries. Among the number of endodontic articles published from 29 countries, Turkey stood first with 962 articles followed by Israel, Iran, Jordan and Saudi Arabia. The rate of science production (GI; growth index) from 1980-1994 to 1995-2009 at the country level had the fastest growth in Iran (GI of 14.4). Iran has experienced a considerable growth in PubMed-indexed endodontic articles with a total of 82 and 54 endodontic articles in 2010 and 2011 respectively. Though, Iran was amongst the top countries in 2010, it stood behind Turkey in 2011 with a significant difference.

Sinha and Joshi (2012) undertook a research to analyze Indian solar photovoltaics research output to identify the research profile of Indian institutes and Indian authors, their collaboration pattern and impact of their research output. Published literature was originated from 33 countries and from 481 journals. Only 10% was published in Indian journals and the rest of 90% was from foreign journals. Among these, highest number of papers in journals originated from USA, followed by England and the Netherlands. Bilateral collaborative papers were high rather than that of any other collaboration. And there seems to be a balance between the domestic and international collaboration in Solar PV research in India.

Bala and Gupta (2012) had quantitatively analyzed world publications on Measles research during 2001-2010 by retrieving the data from Scopus database. The study findings showed that the world’s publications output on measles research was increased from 4701 to 5128 papers from 2001-2005 to 2006-2010. The international collaborative share of various countries varied from 15.70% to 60.65%. The largest number of collaborative links was between USA and UK (148) followed by USA and Switzerland
(112), USA and Canada (70), USA and Germany (65) and Germany and UK (58). The study identified the necessity to improve the policy-making and delivering strategies of measles vaccine in the developing countries.

Cantos-Mateos, Vargas-Quesada, Chinchilla-Rodríguez and Zulueta (2012) undertook a study to identify the main research areas of stem cell research with Keyword plus (1997-2007). Data was extracted from Science Citation Index (SCI) database and the Journal Citation Report (JCR) of Thomson Reuters about scientific output and the impact factor of the journals where Spanish researchers had published their findings in the respective field of study. There was a clear rise in the production of stem cell research. The authorship pattern and productivity indicators reflected a coherent relation and a stable growth in the study period. Bilateral collaboration was found dominant than other lateral relationships. The subject “hematology” accounted for 42% of total publications. Maximum number of publications was received from the journal “Bone Marrow Transplantation and Blood”.

Mooghal, Alijani, Karami and Khasseh (2012) made a quantitative analysis on scientometric research literature using bibliographic records from the Social Science Citation Index, Science Citation Index, and Arts & Humanities Citation Index. The study revealed that out of 691 articles in the field of Scientometrics, the top ten authors together contributed 183 articles (26.48%) during 1980 to 2009. It also identified that researchers of several nationalities were working on the scientometric themes, with a predominance of USA researchers with almost 14.62% publications. USA was the first collaborator of Iranian authors in their research. ‘Hungarian Academy of Sciences’ was the most productive institution in the field of Scientometrics with 40 records (5.71%). The scientific production in the field of Scientometrics showed a mild increase from 1980 to 2009. The most prolific journal in this field was “International journal of Scientometrics”. 67.87% of the scientometrics literature was published from the area of Library and Information Science.
Chen and Guan (2011) investigated of research performance in emerging nano-biopharmaceuticals (1991-2008) from the data sets of WoS, MEDLINE and BIOSIS reviews. The structural and intellectual bases of research front were identified using Cite Space. Using visual mapping structures, it was identified that drug development for improving bio-distribution, bio-availability and pharmacokinetics, and the drug delivery for improving delivery of existing drugs were the focused research areas. The cross-country comparisons showed that USA was the leading contributor in terms of productivity and impact share. China was the only country whose publications and citation share were increasing during the same period. It was identified that nano-pharmaceuticals scientific research is emerging as a pioneering and multidisciplinary domain from nano-biotechnology.

Garg et al. (2011) explored a study on plant genetics and breeding research during 2005-2009. Out of 32574 papers published, USA was leading in contributions followed by China. Indian contributions were originated from 1806 institutions located in different parts of the country. ‘Indian Council of Agricultural Research’ and the ‘Council of Scientific and Industrial Research’ were the major contributors of the research output. ‘International Centre for Genetics Engineering and Biotechnology’, New Delhi and ‘International Crop Research Institute for Semi Arid and Tropics’ located in India had the highest research impact. International collaboration among the authors was steady at that time. Some of the countries concentrate their research on one or two sub-domains. India’s major research area was varietal improvement / conventional breeding to abiotic stress and marker assisted selection. Publications from India in this field had appeared in 611 journals originated from abroad, especially from USA, Netherlands and England and 41 journals originated in India.

Liu, Zhang and Hong (2011) conducted a bibliometric analysis of Global biodiversity research during 1900-2009. The study revealed that the United States was the largest contributor in global biodiversity research, as the U.S. produced the most single-country and collaborative articles, had the greatest number of top research
institutions, and had a central position in collaboration networks. The study perceived an increasing number of both internationally collaborative and inter-institutionally collaborative articles, with the latter form of collaboration being more prevalent than the former. A keyword analysis found several interesting terminology preferences, confirmed conservation’s central position as a topic in biodiversity research, revealed the adoption of advanced technologies, and demonstrated keen interest in both the patterns and underlying processes of ecosystems.

Sagar and Kademani (2011) assessed the growth and impact of S & T research in Madhya Pradesh. Data was collected from WoS expanded version and grouped under 12 broad subject areas based on WoS subject categories. The highest number of publications was published in the subject “Clinical Medicine” followed by “Chemistry”. Among the international collaborating partners, USA was ranked 1st, followed by England (2nd rank) and Germany (3rd rank); whereas in national collaboration, Chhattisgarh was ranked 1st, and Uttar Pradesh 2nd. Collaboration trend varied from one subject to another; from one branch to another of the same subject. Impact of collaboration on scholarly research resulted in an increase in productivity. It could be seen that more intensive collaboration trend was observed as papers with as many as 52 authors were identified.

Fu, Zhang, Zhao, Huang and Chen (2011) analyzed the documents published on acupuncture research during 1980-2009 and indexed in SCI expanded. Though Letters were the 2nd preferred document type, trend of its publications and citations were decreasing entirely. The publications of all core journals of acupuncture showed an increasing trend. Europe, with 2303 papers, was the largest contributor accounting for 33.53% of all documents with a high h-index value of 66, followed by North America and East Asia with 2,284 (33.26%) and 2,089 (32.53%) papers respectively. USA not only took 1st place in the number of papers and citations, but also showed a significant rising trend over 3 decades, as do England and Germany. The 2000s was the most productive decade for acupuncture related researches. Proportions of single author contributions have presented a decreasing trend in all the countries / regions, while collaboration paper
showed increasing trend worldwide and percentage shares of national collaborations were the highest.

Karpagam, Gopalakrishnan, Natarajan and Babu (2011) analysed the growth pattern of Nanoscience and Nanotechnology literature in India during 1990-2009 (20 years). The Scopus international multidisciplinary bibliographical database has been used to identify the Indian contributions in the field of nanoscience and nanotechnology. The study measures the performance based on several parameters – country, annual growth rate, authorship pattern, collaborative index, collaborative coefficient, modified collaborative coefficient and subject profile. Further the study examines national publication output and impact in terms of average citations per paper, international collaboration output and share, contribution and impact of Indian Institutions and impact of Indian journals.

Konur and Ozcan (2011) explored the characteristics of the literature on the algae and bio-energy published during the last three decades, based on the database of Science Citation Index-Expanded (SCIE) and Social Sciences Citation Index (SSCI) and its implications using the scientometric techniques. The results of this work revealed that the literature on the algae and bio-energy has grown exponentially during this period reaching 717 papers in total. Most of the documents is in the form of journal articles, reviews, and proceedings, constituting 98% of the total literature and English is the predominant language (97.6%). USA, China, Germany, and England are the four biggest contributing countries on the algae and bio-energy literature publishing, 26%, 8%, 8%, and 8% of the sample, respectively. ‘The Chinese Academy of Sciences’ is the largest institutional contributor publishing 2.6% of the papers. The most publishing four authors are Wilhelm (18 papers) followed by Wu (15 papers), Mimuro (10 papers), and Zhao (9 papers). "Bioresource Technology" is the most publishing journal with 24 published papers, followed by " Journal of Applied Phycology" (17 papers), and " Biotechnology and Bioengineering" (15 papers). "Biotechnology & Applied Microbiology" is the subject area with 24.3% of the sample published. This is followed by "Energy & Fuels" (16.3%),
"Marine & Freshwater Biology" (14.2%), and "Environmental Sciences" (12.3%). The total number of citations is 11,079, giving a ratio for the "Average Citations per Item" as 15.45 and "H-index" as 52. A list of most-cited 25 authors is produced and Chisti (2007) receives 320 citations with 80 total average citations per year. This paper is followed by Lewis and Nocera (2006; 296 citations), Demirbas (2001; 187 citations). Chisti (2007) has the highest impact on the literature on the algae and energy with total average citations per year of 80. This is followed by Lewis and Nocera (2006, 59.8 annual citations) and Chisti (2008, 41 annual citations).

**Velvizhi, Murugesapandian, Surulinathi, and Srinivasaragavan (2011)** analysed the Indian literature output scanned in Web of Science during 1999–2011 on solar energy research to find out the rate and pattern of growth of the literature. The contribution of Indian Institutions and Global Citation Scores, h-index, g-index and gh-index have been analysed. The area of solar fuels and Material sciences (multidisciplinary) has received maximum attention. Publication output of literature by different countries follows collaborative trend in basic sciences. USA and South Korea are the major solar energy producers with India.

**Biglu, Eskandari and Asgharzadeh (2011)** studied literature on nanotechnology in medicine during 2001-10. Data on patent applications was obtained from WIPO (World Intellectual Property Organization) Statistics Database. Database of Science Citation Index Expanded (SCIE) was selected from Web of Science to obtain publications indexed under the topic “nanotechnology”. The study revealed that the number of publications in 2010 was 84 times greater than those in 2001. English language consisting of 98% of total publications was the most dominant language of publications. Based on Bradford’s scattering’s law, the journal of “Nanoscience and Nanotechnology” distributing 12.8% of total publications was the most prolific journal. USA was the most productive country contributing 39% of world’s publications followed by China (10%), Germany (6%), Japan (6%), Korea (5%) and UK (4%). The majority of world’s publications (70%) were produced by these six countries.
Ahila and Nagarajan (2011) analyzed the research output performance on Pharmacology. A total of 22,065 research articles published in Web of Science were analyzed to find the performance of scientists from all over the world in terms of growth during the period 1999 - 2010 (12 years). Annual growth rate, global publication share and rank among 15 countries of the world, authorship pattern, high productive Institutions, Journals, etc. were analyzed.

Jaric and Gessner (2011) carried out a study on Analysis of publications on sturgeon research between 1996 and 2010. The results revealed that although all 27 sturgeon species have been objects of the research, species that are endangered or facing a high probability of extinction have received disproportionately less attention. White sturgeon was the most frequently studied species, but it was recently surpassed by Persian sturgeon. Early life phases have been among the central objects of the research, and genetics, especially the use of microsatellite DNA was becoming increasingly popular and had the highest impact. Research related to aquaculture was prominent, while the research related to hybrids (as a commodity of aquaculture production) was decreasing in popularity. The study dealt with conservation issues were most frequently focused on European sturgeon. A steady increase in the number of published articles over time was observed. However, the overall citation rate declined significantly over time. During the period reviewed, the sturgeon research published in peer reviewed journals dominantly originated from the USA and EU. Nevertheless, considering the current trend in output, it was very likely that the Asian countries, mainly Iran and China, will surpass them within the next 5–10 years.

Sagar, Kademani and Bhanumathy (2010) made a scientometric analysis of all Tsunami related publications as per the Scopus TM database during 1997-2008. A total of 4338 publications and 21107 citations to these papers were studied. The parameters studied include growth of publication, country-wise distribution of publications, activity index of countries, most-frequently cited publications, authorship pattern, co-authorship index, and distribution of keywords. United States of America, Japan, United Kingdom,
India and Australia produced 54.20% of the total output. The authorship and collaboration trend is towards multi-authored papers. Researchers in Japan, India, Italy and France prefer to work in larger groups when compared to scientists in USA, United Kingdom and Australia whose researchers prefer to work in smaller groups. Researchers preferred to publish in journals and the highly cited journals in the field were: ‘Geophysical Research Letters’ with 130 publications, ‘Marine Geology’ with 64 publications, ‘Journal of Geophysical Research B: Solid Earth’ with 39 publications and ‘Sedimentary Geology’ with 53 publications.

Zell et al. (2010) undertook a comparative study on the research output of air pollution based on the data from Web of Science and PubMed databases. The preferred medium for publishing research literature on air pollution was the articles and the major contributions were made by US. UK and Germany were ranked 2nd and 3rd. Out of ten most publishing journals, nine dealt with the environmental subject matters and one with epidemiology. Analysis of subject areas revealed that among the top ten areas, only two involved medical issues.

Fu, Ho, Sui and Li (2010) conducted a bibliometric analysis of solid waste research to evaluate the current trends, using the literature in the Science Citation Index (SCI) database from 1993 to 2008. Analyzed aspects included document type, language, and publication output as well as distribution of journals, subject category, countries, institutes, title-words, author keywords, and ‘Keywords Plus’. An evaluating indicator, h-index, was applied to characterize the solid waste publications. The trend of publication outputs during 1993-2008 coincided with a power and an exponential model. Based on the exponential model during 2001-2008, the number of articles on solid waste in 2013 is predicted to be twice that in 2008. The most common subject category was ‘environmental science’ and the most productive journal is ‘Waste Management’. The USA with most publications and China with the highest growth rate were compared. The results showed that mainstream research was centered on the following methods: recycling, land filling, composting and waste-to-energy.
Neff and Corley (2009) used a bibliometric tool of co-word analysis to identify trends in the methods and subjects of ecology during the period 1970-2005. Few previous co-word analyses have attempted to analyze fields as large as ecology. The study utilized a method of isolating concepts and methods in large datasets that undergo the most significant upward and downward trends. The study identified policy-relevant trends in the field of ecology, a discipline that helps to identify and frame many contemporary policy problems. The results provide a new foundation for exploring the relations among public policies, technological change, and the evolution of science priorities.

Ahmed and Rahman (2009) examined the validity of Lotka's law to authorship distribution in the field of nutrition research in Bangladesh. Using "full productivity" of authorship, a total of 998 personal author names were identified. Lotka's law was tested using both generalized and modified forms and Kolmogorov-Smirnov goodness-of-fit tests were applied. The results suggest that author productivity distribution predicted in Lotka's generalized inverse square law is not applicable to nutrition research of Bangladesh. Using least-squares excluding high productive authors and maximum likelihood methods, Lotka's law is found to be applicable to nutrition research of Bangladesh.

Gokceoglu, Okay and Sezer (2008) investigated the publication trends in the international earth science literature coming out of Turkey during 1970–2005 using the Science Citation Index Expanded database. A database of 2310 earth science publications with at least one of the authors with an address in Turkey was compiled. The number of earth science publications from Turkey shows a very rapid increase starting in the 1990’s in parallel with the increase in the total scientific output of Turkey. In the last decade the annual growth rate has been 16%. There was also a concomitant increase in the number of citations. The causes of the sharp increase in the publication numbers are, in order of importance, changes in the rules of academic promotion and appointment, changes in academic attitudes towards publishing, increasing support for research, financial incentives for publishing, and expansion of higher education. Although publications with first authors
from outside Turkey make up only 20% of the Turkish earth science publications in the period 1970-2005, these account for 38% of the total citations, and constitute 48 out of 100 most cited papers.

**Surwase, Kademani and Kumar (2008)** carried out a scientometric study to highlight the Neutron Scattering research in India as per the number of publications appeared in the Scopus database. During the period of 1991-2006, a total of 1808 publications were published by the Indian scientists in the field of Neutron Scattering. The average number of publications published per year was 113. The highest number of publications (284) was published in the year 2006. Authorship and collaboration trend was towards multi-authored publications. There were 934 international collaborative publications. India had the highest number of collaborative publications (169, 18.09 per cent) with USA followed by France with 116 (12.42 per cent), Germany with 106 (11.35 per cent), and Japan with 83 (8.89 per cent) publications. The most productive Indian institutions were: ‘Bhabha Atomic Research Centre’, Mumbai with 425 publications followed by ‘Indian Institute of Science’, Bangalore with 183 publications, ‘Saha Institute of Nuclear Physics’, Kolkata with 99 publications and ‘Tata Institute of Fundamental Research’, Mumbai with 97 publications. The most preferred journals by the scientists for publication were: ‘Physical Review-B’ with 129 publications followed by ‘Physical-B’ with 80 publications, ‘Journal of Physical Chemistry-B’ with 76 publications, ‘Pramana-Journal of Physics’ with 75 publications and ‘Journal of Physics Condensed Matter’ with 51 publications. The high frequency keywords were: ‘neutron scattering’ (266), ‘micelles’ (183), ‘surface active agents’ (104), ‘molecular dynamics’ (98), ‘phase transitions’ (96), ‘phonons’ (84) and ‘small angle neutron scattering’ (84).

**Kademani, Sagar, Kumar and Kumar (2008)** attempted to analyse the growth and development of Vacuum research in Nuclear Science and Technology, as reflected in publication output covered by International Nuclear Information System (INIS) database during 2002-2006. A total of 12027 papers were published in the field of vacuum science. United States topped the list with 1936 (16.10%) publications followed by Japan
with 1770 (14.70%) publications. The highest number of publications (3276) was published in 2004. The average number of publications published per year was 2405.4. The highest number of publications was in 'Physics of Elementary Particles and Fields' with 2644 (21.98%) publications. The authorship of collaboration trend is towards multi-authored papers. The highly productive institutions were: ‘Japan Atomic Energy Research Institute’ (Japan) with 366 publications, ‘University of Tokyo’ (Japan) with 274 publications, ‘Hiroshima University’ (Japan) with 245 publications, ‘Osaka University Japan’ (Japan) with 224 publications and ‘Chinese Academy of Science’ (P-R-China) with 223 publications. The most preferred journals for publication were: ‘Journal of Vacuum Science and Technology-A’ with 857 papers, ‘Physical Review –D’ with 765 papers, ‘Journal of High Energy Physics’ with 500 papers, ‘Thin Solid Films’ with 311 papers, ‘Journal of Electron Spectroscopy and Related Phenomena’ with 309 papers, and ‘AIP Conference Proceedings’ with 308 papers.

**Celiktas, Sevgili and Kocar (2008)** analysed 12,197 publications in their study on renewable energy and found that 1555 papers focused on renewable energy between 1980 and 2008 with the contribution from 1605 authors. This study revealed that 94.5% of the publications were in the form of articles and all the publications were written in English.

**Groneberg-Kloft et al. (2008)** assessed benchmarking of research output on organ systems by using large data bases of research output. Specific areas of major research activity were identified by comparing publication density on different organ systems and inter and intra field comparison was performed for selected countries. Novel density-equalizing mappings were constructed that illustrate trends of publication activity and identify subsets of major interest in a total of 5,527,558 published items. A dichotomy was present between Western countries such as the US, UK or Germany and Asian countries such as Japan, China or South Korea concerning research focuses.

**Surwase, Kademani and Vijaikumar (2008)** attempted to highlight the growth and development of world literature of pulsed laser deposition research during 1982-2006. Out of 8534 papers produced by 84 countries, the highest number of papers was
published in 2005. USA was the leading country with 2014 papers followed by Japan with 1553 publications. 97.70% of the publications were multi-authored and 2.30% was single authored papers. ‘Tata Institute of Fundamental Research’, Mumbai and ‘Indian Institute of Science’, Bangalore were found as the most productive Indian institutes.

Kademani, Surwase and Kumar (2007) highlighted quantitatively the growth and development of world literature on Raman spectroscopy in terms of publication output as per Science Citation Index (1982-2005). During 1982-2005 a total of 42804 papers were published by the scientists in the field ‘Raman spectroscopy’. The average number of publications published per year was 1783.5. The highest number of papers (3563) was published in 2005. There were 127 countries involved in the research in this field. USA is the top producing country with 12140 publications (22.48%) followed by Japan with 5287 publications (9.79%), Germany with 4354 publications (8.06%), France with 4045 publications (7.49%), Peoples-R-China with 3031 publications (5.61%) and England with 2799 publications (5.18). Authorship and collaboration trend was towards multi-authored papers. There were 40553 collaborative papers. Bilateral collaboration accounted for 7628 (17.82%) percent of total collaborative papers. ‘Russian Academy of Sciences’ (Russia) topped the list with 874 publications followed by ‘Chinese Academy of Sciences’ (Peoples-R-China) with 714 publications, ‘CNRS’ (France) with 566 publications. The most prolific authors were: J.R. Durig with 347 publications, H.G.M. Edwards with 276 publications, T.G. Spiro with 253 publications, W. Kiefer with 247 publications, and R.L. Frost with 202 publications. The most preferred journals by the scientists were: ‘Journal of Raman Spectroscopy’ with 1867 publications, ‘Journal of Molecular Structure’ with 1361 publications, ‘Journal of Chemical Physics’ with 1034 publications, ‘Journal of Applied Physics’ with 964 publications and ‘Applied Spectroscopy’ with 917 publications. The high frequency keywords were: ‘Raman Spectroscopy’ (4835), ‘Spectroscopy’ (3467), ‘Spectra’ (3334), ‘Scattering’ (2947) and ‘Films’ (1643).

Chiu and Ho (2007) analyzed parameters like document type, language of publication, publication output, authorship, publication patterns, distribution of subject
category, distribution of author keywords, country of publication, most-frequently cited article, and document distribution after the Indonesia tsunami. The US and Japan produced 53% of the total output where the seven major industrial countries accounted for the majority of the total production. English was the dominant language, comprising 95% of articles. A simulation model was applied to describe the relationship between the number of authors and the number of articles, the number of journals and the number of articles, and the percentage of total articles and the number of times a certain keyword was used. Moreover the tsunami publication patterns in the first 8 months after the Indonesia tsunami occurred on 26 December 2004 indicated a high percentage of non-article publications and more documents being published in journals with higher impact factors.

Pouris (2007) reported the findings of a scientometric analysis of nanoscale research in South Africa during the period 2000-2005. The ISI databases were identified as the most appropriate information platform for the objectives of the investigation and were interrogated for the identification of South African authors publishing in the field. The major findings of the investigation are as follows: nanoscale research in South Africa is driven by individual researchers interests up to date and it is in its early stages of development; the country's nanoscale research is below what would one expect in light of its overall publication output; the country's nano-research is distributed to a number of Universities with subcritical concentration of researchers.

Rajendiran and Parihar (2007) studied about the laser literature in India, 1995-2005 and measured the quantitative distribution of literature source-wise and author-wise and degree of collaboration among authors. The journal distribution fits the typical Bradford S-shape curve. The degree of collaboration among authors was 0.94. Majority of authors contributed only one article (65.04%) which was larger than the 60% of original Lotka’s data. Literature was scattered into eight different disciplines.

Kademani, Sagar, Kumar and Gupta (2007) attempted to analyze science and technology literature in India from SCI during 1990-2004. The study analyzed the features of Indian S&T by focusing on publication growth pattern, research quality,
institutional productivity, collaboration, and subject areas of interests. Among top 10 countries, USA topped the list followed by Japan. India was ranked 15\textsuperscript{th} in total contributions. Most of the contributions were in the low impact journals. The subject area chemistry was the interesting subject followed by Physics, Basic Science, Engineering, Clinical Medicine and so on. India’s international collaboration was increased from 12.55 \% to 21.11\%. India’s major collaborator was USA. In European countries, India’s major collaborator was Germany followed by England.

\textbf{Ramakrishnan and Rameshbabu (2007)} presented a bibliometric analysis of the literature output for the period 1984-2003 in the field of \textit{Hepatitis} covered by the databases namely MEDLINE, CINAHL and IPA. There were 79312 records covered by these databases on hepatitis during the study period after the removal of duplicate records. The percentage of publications on hepatitis was 0.84\% in 1984 and 1.08\% in 2003 in MEDLINE database; 0.39\% in 1984 and 0.65\% in 2003 in CINAHL and 0.57\% in 1984 and 1.30\% in 2003 in IPA. 82.6\% of records were articles followed by letters (5.3\%) and comments (3.04\%). Papers with more than five authors were significantly higher followed by single authored papers. 85.17\% of contributions were out of collaborative research with different degree of collaboration. Higher level of degree of collaboration was identified in Hepatitis research.

\textbf{Wen, Ho, Jian, Li and Hsu (2007)} in their study on \textit{Electronic Health Record} (EHR) from 1991 to 2005 analysed 1455 articles. About 80.7\% of the publications were articles followed by meeting abstracts. The number of published articles has increased when compared by each 5 year period. The top 10 of the 374 journals accounted for 41\% of the number of published articles. The US dominated the publication profile. An analysis of the number of articles related to population revealed a high publication output for relatively small countries like Switzerland, the Netherlands and Norway.

\textbf{Behrens and Luksch (2006)} applied the mathematical and statistical techniques of bibliometrics to the field of \textit{crystallography}. The study was restricted to inorganic compounds. The data were taken from the Inorganic Crystal Structure Database, which
was well defined and evaluated body of literature and data published from 1913 to 2005. The data were loaded in a relational database system, which allows a widespread analysis. The cumulative growth rate of the number of experimentally determined crystal structures is best described by a third-degree polynomial function. Except for the upper end of the curve, Bradford's plot can be described well by the analytical Leimkuhler function. The publication process is dominated by a small number of periodicals. The probability of the author productivity in terms of publications follows an inverse power law of the Lotka form and in terms of database entries an inverse power law in the Mandelbrot form. Authorship pattern has increased from 1.4 authors per publication to about four within the past eight decades. The author distribution itself is represented by a lognormal distribution.

**Tsay and Yang (2005)** investigated the growth of Randomized Controlled Trial (RCT) literature based on the MEDLINE database and explored the various features of the literature using well-established bibliometric methods. The study summarized that the RCT literature from 1965 to 2001 grew exponentially, indicated that the growth of RCT literature maintains a constant rate for the period of the study; the yearly growth rate was about 11.2%. Journal article (98%) was the single most common form of publication covered in MEDLINE. The subject areas that employed RCT methods the most include drug therapy for hypertension, therapeutic use of combined antineo plastic agents and drug therapy in asthma. Using Bradford zone analysis and the Bradford-Zipf plot, core journals (42) (containing 25% of the RCT literature) have been identified. Most of the core journals dealt with anaesthesia, pharmacology and pharmacy, cardiac and cardiovascular systems, and general and internal medicine. The journals with impact factor greater than ten are related to general and internal medicine.

**Basu and Lewison (2005)** studied the characteristics of the world astronomy research during the last decade using Science Citation Index. Potential citation impact was determined from journal citation scores, and multiple regression analysis was used to evaluate leading countries. The study found that Indian astronomy output increased in potential impact partly through greater international co-authorship and partly through
indigenous collaboration. Potential impact increased with more authors per paper from various institutions. Potential impact was greater for papers from Canada, UK and USA and lesser for papers from China, India and Russia.

**Ho, Chiu, Tseng and Chiu (2003)** used Honor index in his study to determine the scientific productivity of *stem cell research* in the Asian Four Dragons (Hong Kong, Singapore, South Korea and Taiwan) from 1981 to 2001. The methodology applied in this study represents a synthesis of universal indicator studies and bibliometric analyses of subfields at the micro-level. The Honor Index, a method to evaluate research performance within different research fields, was derived from the impact factor. The study discussed several comparisons and revealed a developmental trend in stem cell research for two decades.

**Gupta, Dhawan, Bose and Mishra (2002)** undertook a research to trace out India’s collaboration with Australia in *Science and Technology*. Co-author analysis was used to identify the mode, extent and directions of collaborations between the countries in science and technology. This collaboration mainly took place through bilateral efforts and account for 62.11% of the total collaborated papers. Clinical medicine, Chemistry, Physics and Earth & Space sciences were the priority areas for collaborative research. A total of 124 Indian and 76 Australian institutions were involved in joint collaborative research during the period under study.

**Shukla, Saksena and Riswadkar (2001)** applied Bradford's Law of scattering and Lotka's Law of productivity to *bio-energy literature* and verified if the law holds good for ten abstracting services (eight international and two Indian). It has been verified that literature related to bio-energy conforms to Bradford's law of scattering and that grouping of services (all services together) also yields a Bradford distribution. The new model developed in this study fits the data very satisfactorily as ‘r’ value ranged from 0.952 to 0.998 (for papers from journal titles) and 0.989 to 0.998 (for papers from conference proceedings). The value of p (multiplication factor) for bio-energy literature ranged from 2.19 to 4.09 for articles from journal titles and from 2.02 to 4.59 for papers from
conference titles. Results of linear regression showed that Lotka's distribution holds good for bio-energy literature and the value of ‘n’ ranged between 2.5 and 4.5.

**Karki and Garg (1999)** assessed the research performance on *organic chemistry* by India using the scientometric tools and identified the potential of the scientific research activities. The study revealed that the literature appeared in international journals has larger visibility and wider readership possibility, hence it reflected higher potential connectivity compared to that appeared in Indian journals. India had poor main stream connectivity in organic chemistry research. The mean impact factor (IF) and relative quality index (RQI) were found to be 1.4 and 8.26 respectively.

### 2.3 STUDIES ON INDIVIDUAL JOURNALS, INSTITUTIONS AND AUTHORS OF A PARTICULAR COUNTRY

**Ghar and Urkudkar (2016)** did a bibliometric study on "*Journal of Biosciences*" for the period 1979 to 2015. The data were downloaded from the journal's website. The analysis focused on: the research output performance of all areas of Biology; number of citations; authorship pattern of cited references; Age of citation references etc. The result showed that *Journal of Biosciences* published a total 2157 research papers from 1979 to 2015. The maximum number of citations 3988 (5.67 %) were produced in 2007. The maximum (20390, 28.99%) citations involved just two authors.

**Gogoi and Barooah (2016)** conducted a bibliometric study on “*Indian Journal of chemistry*” to understand the usage pattern of information in the field of Material science and to ascertain the types of documents most frequently used in the research process. The study reveals that: Authorship trend is towards team works rather than a work in isolation. Most of the publications cited are articles in journals; the number of references in other kinds of documents such as books/monographs, conference proceedings, theses/dissertation etc. are small. Among the citations from journal literature, majority are from foreign journals though the journals of Indian origin have also extensively used by the researchers. The most frequently cited journal titles were ‘*Tetrahedron Letter*’, ‘*Journal of Medicinal Chemistry*’ and ‘*Journal of Organic Chemistry*’. The year wise distribution of
The cited documents reveal that publications of pre-1950s still continue to be cited in the source journal. The year-wise distribution of journals indicated that journals published from 2000-09 are highly preferred.

Bala and Singh (2014) critically analysed 316 scholarly communications published in the ‘Indian Journal of Biochemistry & Bio-Physics’, formerly known as IJBB. It is a peer reviewed, open access bi-monthly Journal published by NISCAIR. The analysis cover mainly the number of articles, form of document cited, most cited Journals etc. Study reveals that single author contributed 18 (5.7%) while the rest of 162 (51.3%) articles were contributed by Multi authors. The contributions in this Journal from India are slightly more than those from other countries.

Mishra (2014) presented a bibliometric analysis of the ‘Health and Population: Perspectives Issues Journal’ during the year 2001-2010. The study analyzed 254 articles published during the period. The analyses cover the bibliometric analyses of year-wise distribution of articles, subject-wise distribution of articles, authorship patterns, citation count and geographical distribution of contributions. The study revealed that the maximum 34 (13.39%) papers were published in the year 2008 and the mean number of published papers per year was 23.09. Majority of contributions appeared under contraception (27, 10.63%) while the next position was taken by health policy/programmes (19, 7.48%). It was followed by epidemiology with 18 (7.09%) articles and reproductive health by 17 (6.69%) articles. Majority of articles 127 (50%) were contributed from Delhi state and only 1 (0.39%) article has been contributed from each of Assam, Goa, Himachal Pradesh, Meghalaya and West Bengal. Contribution from foreign countries has also been counted as 4 (1.57%) articles. The study revealed that maximum number of citations accounted for the period of study were 441 (13.61%) citations reported in 2010 while the minimum 193 (5.95%) were found in year 2000.

Rajendran, Jeyshankar and Elango (2011) analysed 506 papers published during 2001-2010 in the Indian Journal of Marine Sciences using tools such as exponential
growth, co-authorship index, publication efficiency index (PEI), collaboration index and research length index. Pattern of co-authorship indicates the world average for the multi authors. India is the most producing country to the journal literature. Review articles have attained the higher value of PEI.

**Suluimanov, Frolova and Khasenova (2009)** analysed the results of the scientometric analysis of foreign publications by Kazakh authors that reflected in the SCOPUS database in 1991-2008. The publication activity is expressed in 3883 documents, the citation index of which is 10 132. The average share of Kazakh publications in the total worldwide flow is equal to 0.017%. The citation rate of publications was revealed to have significantly grown since the 1996-2000 period. It is shown that most articles were written in English and published in periodical editions. The main themes of publications are represented by physics and chemistry. The leading foreign partners of Kazakhstan in the scientific sphere were determined. Kazakh-Russian scientific cooperation is developing most fruitfully in the present century.

**Swarna, Kalyane and Vijaikumar (2002)** investigated the technical reports of Bhabha Atomic Research Centre during 1990-99. Out of 554 technical reports produced in the study period, “Engineering and Technology” generated 207 technical reports followed by Chemistry, Materials and Earth Sciences. Conventional sources (85%) like journals, books, standards, manuals and patents were preferred as references. About 36% of self citations of the same institution were found in the total technical reports cited. Conference literature forms a vital communication link in the field of Engineering and Science. It was found that the technical reports were accepted as a medium of dissemination of technical data and information gathered through research efforts.

### 2.4 STUDIES ON ARTS, HUMANITIES AND SOCIAL SCIENCE SUBJECTS

**Manikandan and Amsaveni (2016)** quantitatively analyzed the research trends in Management Information System with the help of scientific publications reflected in the popular database ‘Web of Science’ during the period 1989 to 2013 (totally 25 years). The
active author is “Huang G H” from ‘China Agricultural University’. Majority of articles are published by two, three and four authors’ team indicating really a positive aspect in collaboration. The highest contributing authors are the ‘three authors’ team’. The highest exponential growth rate of 4.32% was found during the year 1991.

**Nwagwu and Egbon (2011)** analyzed the publications of Nigeria’s social science literature indexed in the Arts and Humanities Citation Index and Social Science Citation Index to understand the research publications dynamics. Although there were about 98 universities and 30 research institutes in Nigeria who conduct research and publish them in primary journals, there was hardly a coordinated national system of science. There was no single national database of university researchers, neither any national database of research outputs. Even at the institutional level, there was hardly any coordinated expression that researchers’ outputs require to be managed in order to benchmark research both in the institutions and in the national system of science. This study evidenced that Nigerian social science and arts and humanities literature has penetrated the international social science community.

**Tian, Wen and Hong (2008)** analysed the global scientific production on Geographic Information System (GIS) research by bibliometric analysis from 1997 to 2006. The analysis showed that GIS research steadily increased over the decade and the annual production in 2006 was about three times that of the annual production of 1997.

**Al, Şahiner and Tonta (2006)** investigated the bibliometric characteristics of 507 arts and humanities journal articles written by authors affiliated with Turkish institutions and indexed in the Arts & Humanities Citation Index (A&HCI) between the years 1975–2003. Journal articles constituted more than 60% of all publications. One third of all contributions were published during the last 4 years (1999–2003) and appeared in 16 different journals. An overwhelming majority of contributions (91%) were written in English, and 83% of them had single authorship. Researchers based at Turkish universities produced 90% of all publications. Two thirds of references in publications were to monographs. The median age of all references was 12 years. Eighty percent of publications
authored by Turkish arts and humanities scholars were not cited at all while the remaining 20% (or 99 publications) were cited 304 times (an average of three citations per publication). Self-citation ratio was 31%. Two thirds of the cited publications were cited for the first time within 2 years of their publications.

Angadi, Koganuramath, Kademani and Kumbar (2006) analysed quantitatively 358 publications published by the social scientists of ‘Tata Institute of Social Sciences’ during 2001-2004 in various Departments and Research Units to understand authorship pattern and collaboration trend. The results indicate that 90.22 % of papers were single authored followed by two authored papers - 5.86 % and three authored papers - 3.35 %. Most prolific authors were Shalini Bharat (21), M. M. Koganuramath (18), Mallikarjun Angadi (13), R. N. Sharma (13), Chhaya Datar (12), Siva Raju (12), and Sarthi Acharya (10). The most preferred journals by the social scientists were: ‘Economic and Political Weekly’, ‘Indian Journal of Social Work’ and ‘Indian Journal of Labour Economics’, with four papers each. Publication Density observed in the present study was 1.46.

2.2.4 STUDIES ON EARTHQUAKES

Liu, Zhan, Hong, Niu and Liu (2012) conducted a study to evaluate the earthquake research performance based on a bibliometric analysis of 84,051 documents published in journals and other outlets contained in the Scientific Citation Index (SCI) and Social Science Citation Index (SSCI) bibliographic databases for the period of 1900-2010. The study summarized significant publication indicators in earthquake research, evaluated national and institutional research performance, and presented earthquake research development from a supplementary perspective. Research output descriptors suggested a solid development in earthquake research, in terms of increasing scientific production and research collaboration. The study identified leading authors, institutions, and nations in earthquake research, and there was an uneven distribution of publications at authorial, institutional, and national levels. The most commonly used keywords appeared in the articles were evolution, California, deformation, model, inversion, seismicity, tectonics, crustal structure, fault, zone, lithosphere, and attenuation.
Li et al. (2009) conducted a comparative study on earthquake-related literature published in medical journals. There were relatively fewer quake related articles globally before the occurrence of the Wenchuan earthquake, and the quantity of papers in MEDLINE was four times than that in CBM. In contrast, the quantity of Chinese quake articles increased rapidly after Wenchuan earthquake, peaking in Aug. 2008 at 6.9 times the average during the 50 years before the quake. The quake related papers in CBM appeared in 378 journals covering a diverse range of subject matter. Meanwhile, there was little change in the quantity of quake related articles in MEDLINE database. The study concluded that the effort of producing and disseminating Wenchuan earthquake related medical research has been effectively organized and conducted in a scientific and timely manner, producing the largest number of quake related medical papers in human history. It has provided first-hand guidance for disaster medical relief around the globe.

2.3 INFERENCES

2.3.1 Authorship Pattern of the Reviews

Out of 83 reviews, only 10 are contributed by single authors. The remaining 73 are contributed by multiple authors. Out of 10 single authored articles, nine are from Indian authors and only one article is from a foreign author. Two single authored articles were published in 2015, 4 in 2014, 3 in 2013 and one in 2007.

There are 28 articles published in two author style. 17 articles are contributed by the Indians and 11 articles are contributed by the foreign authors. Four articles were published in 2016, 4 in 2015, 3 in 2014, two in 2012, 6 in 2011, two in 2009, three in 2007, 1 in 2006, 2 in 2005 and 1 in 1999.

23 articles are contributed by three author pattern. 12 are contributed by Indian authors and 11 are of non-Indian origin. One article was published in 2015, 3 in 2014, 4 in 2013, 1 in 2012, 4 in 2011, 1 in 2010, 1 in 2009, 5 in 2008, 1 in 2007, 1 in 2003 and 1 in 2002.
The four author pattern has contributed 11 articles of which 7 are by Indian authors and 4 are by foreign authors. 1 article was published in 2013, 2 in 2012, 2 in 2011 and 1 each in 2010, 2008, 2007, 2006, 2003 and 2002.

### Table 2.1

**Authorship Pattern of the Reviews**

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<th>S.No</th>
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<th>Single Author</th>
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</tr>
<tr>
<td>9</td>
<td>2010</td>
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<td>0</td>
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<td>1</td>
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</tr>
<tr>
<td>10</td>
<td>2011</td>
<td>0</td>
<td>6</td>
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</tr>
<tr>
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<tr>
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<td>4</td>
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<td>1</td>
</tr>
<tr>
<td>13</td>
<td>2014</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>2015</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>2016</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td><strong>28</strong></td>
<td><strong>23</strong></td>
<td><strong>11</strong></td>
<td><strong>5</strong></td>
<td><strong>6</strong></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td><strong>Percentage</strong></td>
<td><strong>12.05</strong></td>
<td><strong>33.73</strong></td>
<td><strong>27.71</strong></td>
<td><strong>13.25</strong></td>
<td><strong>6.02</strong></td>
<td><strong>7.23</strong></td>
<td><strong>7.23</strong></td>
</tr>
</tbody>
</table>

5 articles are published in five author style. All these five articles are contributed by foreign authors. One each of these articles was published in 2015, 2013, 2012, 2011 and 2007.

More than five author style has contributed 6 articles of which only one is contributed by Indian authors. These 6 articles were published as one each in 2014, 2013, 2011, 2010, 2009 and 2008.
### 2.3.2 Year-Wise Analysis of Reviews

#### Table 2.2

<table>
<thead>
<tr>
<th>S. No</th>
<th>Year</th>
<th>Number of Reviews</th>
<th>%</th>
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<tbody>
<tr>
<td>1</td>
<td>2016</td>
<td>4</td>
<td>4.82</td>
</tr>
<tr>
<td>2</td>
<td>2015</td>
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<td>9.64</td>
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<tr>
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<td>2014</td>
<td>11</td>
<td>13.25</td>
</tr>
<tr>
<td>4</td>
<td>2013</td>
<td>10</td>
<td>12.05</td>
</tr>
<tr>
<td>5</td>
<td>2012</td>
<td>6</td>
<td>7.23</td>
</tr>
<tr>
<td>6</td>
<td>2011</td>
<td>14</td>
<td>16.87</td>
</tr>
<tr>
<td>7</td>
<td>2010</td>
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<td>3.61</td>
</tr>
<tr>
<td>8</td>
<td>2009</td>
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<td>1.20</td>
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<td>2</td>
<td>2.41</td>
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<tr>
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<td>1999</td>
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<td>1.20</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>83</td>
<td>100</td>
</tr>
</tbody>
</table>

Out of 83 reviews, a majority of 14 (16.87%) were published in 2011 followed by 11 (13.25%) in 2014 and 10 (12.05%) in 2013. The year 2015 has contributed 8 articles followed by 7 articles each in 2008 and 2007. Only one article was published in 2003 and 1999.
2.3.3. Nationality of Reviews

<table>
<thead>
<tr>
<th>Nationality / Authorship Pattern</th>
<th>Number of Articles By</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Author</td>
<td>Total</td>
</tr>
<tr>
<td>Indian Authors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Authors</td>
<td>9</td>
<td>46</td>
</tr>
<tr>
<td>3 Authors</td>
<td>17</td>
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<tr>
<td>4 Authors</td>
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<td></td>
</tr>
<tr>
<td>5 Authors</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>&gt; 5 Authors</td>
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</tr>
<tr>
<td>Foreign Authors</td>
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<td></td>
</tr>
<tr>
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<td>3 Authors</td>
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</tr>
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<td>4 Authors</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5 Authors</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>&gt; 5 Authors</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

46 articles are contributed by Indian authors and 37 articles are contributed by foreign authors. While Indian authors have contributed more articles in single author style, two author style, three author style and four author style, foreign authors have contributed more articles in five author style and more than five author style.

2.3.4 Subject-wise Categorization of Reviews

<table>
<thead>
<tr>
<th>S. No</th>
<th>Subject Category</th>
<th>Number of Reviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Studies on various scientific Subjects</td>
<td>69</td>
</tr>
<tr>
<td>2</td>
<td>Studies on Individual Journals, Institutions and authors of a particular country</td>
<td>07</td>
</tr>
<tr>
<td>3</td>
<td>Studies on Arts, Humanities and Social Science Subjects</td>
<td>05</td>
</tr>
<tr>
<td>4</td>
<td>Studies on Earthquakes</td>
<td>02</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>83</td>
</tr>
</tbody>
</table>

Out of 83 reviews, a majority of 69 reviews present a scientometric analysis of various scientific subjects. While 7 reviews are about the scientometric study of individual journals, institutions and authors of a particular country, five reviews indicate scientometric analysis of arts, humanities and social science subjects. Only 2 reviews present scientometric studies on earthquakes.
2.3.5 Summarized Inference

More reviews are two authored and three authored. A maximum number of reviews were published in 2011. More reviews are contributed by Indian authors. The reviews reveal that though en number of scientometric studies were conducted on various science and non-science areas of research output literature, only two studies were conducted globally on earthquake related subjects. This clearly reveals the existence of a giant research gap in the field of scientometric study with respect of seismic research literature.

2.4 CONCLUSION

This chapter has given brief reviews of related literature collected by the researcher in the field of Bibliometrics/ Scientometrics. These reviews have hinted the researcher on various dimensions of research like sources that can be used for data, indicators that can be used for analysis, the tool and techniques that can be used for drawing inferences and the ways of presenting the interpretations. The next chapter will give an overview of the subject ‘Seismic.’
REFERENCES


