CHAPTER II
REVIEW OF LITERATURE

2.1 INTRODUCTION

This chapter devotes to examine the review of works relating to various aspects of bibliometric and Scientometric studies. It could be observed that there are various research studies highlighting the importance of Scientometric analysis and their applications to the library managements and administration. This type of analysis enables the researcher to identify the research gap in the previous studies.

Review of related studies further avoids the duplication work that has already been done in that area. It also helps the researcher to study the different aspects of the problem. It enables the researcher to identify the unexplored areas, in order to create new grounds for research. By considering this efficiency of various dimensions of Scientometric studies, the researcher has presented the literature on the basis of reverse chronological order.

The term, Bibliometrics, was introduced by Alan Pritchard in 1969. Although it seems that the term’s history is new, its origin goes back to Campbell’s study in 1896 according to (Sengupta, 1992). He states that Campbell’s (1896) statistical studies in publications subject categories was the first time for conduction of bibliometric study. Up to Pritchard (1969), bibliometric studies called as statistical bibliography. By it’s nature, the literature of science and technology is the focus of Scientometrics as a field. Van Raan (1997) also emphasized the quantitative study of science and technology while defining the term. Similarly, Concepcion S Wilson, (1999) stated that all quantitative aspects of science of science, communication in science policy are in the content of scientometrics. By considering this efficiency of various dimensions of scientometric studies, the researcher has presented the literature on the basis of chronological order.

Bibliometric studies at the micro level are increasingly requested by science managers and policy makers to support research assessment decisions. Different indicators are frequently developed at this level of analysis, generally based on both the
production of scientists as well as the impact of their documents, such as the number of citations, number of citations per document or the number of highly cited papers. The combined use of several indicators that give information on different aspects of scientific output is generally recommended (i.e., Van Leeuwen, Visser, Moed, Nederhof, & Van Raan, 2003). However, the h-index was introduced in 2005 (Hirsch, 2005), comprising in a single indicator a measure of quantity and impact of the scientific output of a researcher. According to Hirsch, “a scientist has index h if h of his or her Np papers have at least h citations each and the other (Np-h) papers have ≤ h citations each”.

The scientific community has shown a huge interest for this indicator, as shown by the high number of publications on the topic (Ball, 2005; Cho, 2005; Dume, 2005a, 2005b; Glanzel, 2006; Monastersky, 2005; Nazaroff, 2005; Nature, 2005; Popov, 2005). The main advantage of h-index is that it combines a measure of quantity and impact in a single indicator. It has been calculated in different fields such as physics (Hirsch, 2005), biomedicine (Bormann & Daniel, 2005), information science (Cronin & Meho, 2006), and business (Saad, 2006). It can be useful for journal assessment (Braun, Glanzel, & Schubert, 2006; Rousseau, 2006b), for comparative description of scientific topics (Banks, 2006) and also for awarding scientific prizes (Glanzel & Persson, 2005).

2.2 RELATED DISCIPLINE

Philipp Mayr. & Andrea Scharnhorst (2015) revealed the audiences served by IR and scientometrics are very different. The former focuses on users of information systems as implemented on the web, in libraries and archives, the latter in its form of evaluative bibliometrics addresses primarily research manager and science policy makers in universities, funding agencies and ministries. With these different audiences come also different goals towards which algorithms of information processing used in both fields are tailored. IR supports an individual user to find paths through knowledge spaces. While devoted to an as good as possible match between search terms and materials in the collection at hand, serendipity and large coverage of the retrieved set of documents are not unwelcome features. For the evaluation of research groups, the goal is to delineate the field of relevant works as sharply and precisely as possible.
Adele Paul-Hus et.al. (2015) have persisted that several areas of society and scientific research is no exception. This study described the evolution of the place of women in Russian science from 1973 to 2012, in terms of published research output, research productivity, international and national collaboration, and scientific impact, taking into account the socioeconomic, political and historic context of the country, which was marked by the fall of the USSR in 1991. The results show that gender parity is far from being achieved. Women remain underrepresented in terms of their contribution to research output and scientific impact in almost all disciplines, with Mathematics and Physics, research areas in which Russia is specialized, having the largest gap. Men and women show different collaboration patterns on the national and international level, whereas women are preeminent on the national scene and men are on the international one. Although the impact of women’s scientific output significantly increases after the fall of the USSR, the gap between both genders remains stable over time for most of the disciplines. As a result, this increase cannot be interpreted as an improvement of women’s relative influence in Russian science, but rather an improvement of Russian science impact in general.

Julien Pollack & Daniel Adler (2015) were used quantitative techniques to reveal trends in project management related research published between 1962 and 2012. The data set for this research includes 94,472 unique records sourced from the Scopus and ISI Web of Science databases. The keywords and abstracts that authors have used to describe their work have been analyzed in terms of word frequency, rate of change and the co-occurrence of keywords and abstract terms. This data has been used to construct network maps of the field, depicting the relative association between key topics. Comparisons are made between the frequencies of key terms and rapid changes in the ways that terms are used in the literature to identify emergent trends and passing fads. Amongst other findings, this research has revealed evidence to indicate a change in emphasis in project management research from a technical engineering orientation to one which encompasses a broader organizational perspective.

Hock Chuan Chan, Varsha Guness, Hee-Woong Kim (2015) have identified a different and efficiency of the publication of data from Journal Citation Reports (JCR).
This provides aggregate citation data across individual journals. While the findings provide general empirical support for the choice of the AIS basket of eight journals, they also indicate that five additional journals qualify as core information systems journals. Each of these journals has numerous citations of journals within this set and low citations of individual journals outside this set. Furthermore, a network centrality analysis of this set of journals reveals a high correlation between in-degree centrality and the perceived importance of journals. Overall, the study demonstrates the suitability of this method for identifying core journals in a discipline.

Ying Wu & Zhiguang Duan (2015) have studied to investigate the extent of author collaborations in schizophrenia research. This study used 58,107 records on schizophrenia from 2003 to 2012 which were downloaded from Science Citation Index Expanded (SCI Expanded) via Web of Science. Cite Space III, an information visualization and analysis software, was used to make a visual analysis Collaborative author networks within the field of schizophrenia were determined using published documents. They found that external author collaboration networks were more scattered while potential author collaboration networks were more compact. Results from hierarchical clustering analysis showed that the main collaborative field was genetic research in schizophrenia. Based on the results, authors belonging to different institutions and in different countries should be encouraged to collaborate in schizophrenia research.

Rabindra K. Maharana (2014) has studied the research performance of SU’s publications that have been indexed in Scopus during 2008 to 2012. The study also identifies the annual growth of university publication, authorship pattern, author productivity, degree of collaboration, length of paper published, most prolific contributor, prolific institution/organization, geographical distribution etc. Lotka’s law of scientific productivity was used to determine the author’s productivity and Bradford’s is law used to determine scattering of literature in the publication pattern of the university during the period under study.

Prakasan, E. R et.al. (2014) analyzed upward trend in collaborative S&T research at the international level which is significant in the present Information and Communication Technology era. The present study focuses on analyzing India’s
strengths and weaknesses in collaborative research at the international level and collaborative fields are analysed for their macro-and micro-levels. The chronological trend of international collaboration, the collaborative countries, quality of the collaborative publications, collaborative fields, specialization in collaboration, etc. are the main criteria evaluated in the present work.

T. Gorjiara, and C. Baldock (2014) have founded Nanoscience and nanotechnology are research areas of a multidisciplinary nature. Having a good knowledge of the rapidly evolving nature of these research areas is important to understand the research paths, as well as national and global developments in these areas. Accordingly, in this reported study nanoscience and nanotechnology research undertaken globally was compared with that of Australia by way of analyzing research publications. Initially, four different bibliometric Boolean-based search methodologies were used to analyze publications in the Web of Science database (Thomson Reuters ISI Web of Knowledge). These methodologies were (a) lexical query, (b) search in nanoscience and nanotechnology journals, (c) combination of lexical query and journal search and (d) search in the ten nano-journals with the highest impact factors. Based on the results obtained, the third methodology was found to be the most comprehensive approach. Consequently, this search methodology was used to compare global and Australian nanoscience and nanotechnology publications for the period 1988–2000. Results demonstrated that depending on the search technique used, Australia ranks fourteenth to seventeenth internationally with a higher than world average number of nanoscience and nanotechnology publications. Over the last decade, Australia showed a relative growth rate in nanoscience and nanotechnology publications of 16% compared to 12% for the rest of the world. Researchers from China, the USA and the UK are from the main countries that collaborate with Australian researchers in nanoscience and nanotechnology publications.

Weina Hua, Yu Li, Shunbo Yuan (2014) have demonstrated the importance and the actual research situation of Antarctic studies in the humanities and social sciences. They collected data from the SSCI and A&HCI covering a period of over 100 years and focused on the number of articles published each year, major journals, types of document,
authors and their countries publishing the most articles, collaboration, the major research subjects covered, and citations. Comparisons were also made with the Arctic studies to show some similarities and differences. The results suggest that the research in the fields of humanities and social sciences has been in the long-run developing without interruption over 100 years. With regard to the number of articles in high-capacity journals, Geographical Journal performs best, followed by the Peter Manns Geographische Mitteilungen and Scottish Geographical Magazine. The documentation is rather scattered without a strong cohesion, while book review and article are the two most common types of document. There haven’t many stable collaborated teams on Antarctic topics. Joyner, Savours, and Beck are the three authors having the highest number of publications. USA is the most active country while the most active research institute is University of Tasmania in Australia. The Antarctic expedition has been the main theme which lasted for centuries. In addition, research in the fields of humanities and social sciences has generated a lot of high-impact articles, among which the article entitled ‘Chemical concentrations of pollutant lead aerosols, terrestrial dusts and sea salts in Greenland and Antarctic snow strata’” enjoys the highest citation counts.

**Khosrowjerdi, M., & Bayat, M. K. (2013)** has explored the use of scientometric approach to study the scientometrics domain. They responded to these questions: (1) Is the scientometric studies classified in interdisciplinary domain?; (2) What is the contribution of different scientific fields to scientometric studies?; (3) What is the current direction of scientometric studies? The data was extracted from Web of Science (WoS). The results showed that scientometric studies were a part of interdisciplinary studies. Furthermore, the library and information science and computer science had major contribution to this field.

**Shao, H., Yu, Q., Bo, X., & Duan, Z. (2013)** has elucidated the status of oncology research from 2001 to 2010. Studies published in 30 representative oncology journals were retrieved from the Web of Science (2001-2010) to compose our dataset. Knowledge domain visualization, co-citation analysis and social network analysis methods were used. By mapping the oncology research performed from 2001 to 2010, they identified the primary research centres, including the top 20 institutions and
countries and the 4 major oncology research fronts: i) the mechanism of abnormal oncogene expression; ii) tumour metastasis and angiogenesis; iii) the relationship between cancer cells and apoptosis; and iv) tumour vaccines. We also identified the 36 most collaborative academic communities, and multiple myeloma, angiogenesis and acute lymphocytic leukaemia were found to be the focuses of collaborative research in oncology from 2001 to 2010. America has led oncology research, while China is the sole developing country to be ranked in the top 10.

Harzing, A. (2013) have showed 20 Nobelists in Chemistry, Economics, Medicine and Physics and track their h-index, g-index and total citations in Google Scholar on a monthly basis. Our data suggest that-after a period of significant expansion for Chemistry and Physics-Google Scholar coverage is now increasing at a stable rate. Google Scholar also appears to provide comprehensive coverage for the four disciplines we studied. The increased stability and coverage might make Google Scholar much more suitable for research evaluation and bibliometric research purposes than it has been in the past.

Gupta, B. M., & Bala, A. (2013) has analyzed the research output of India in schizophrenia research during 2002-11 on several parameters including the growth, rank and global publications share, citation impact, share of international collaborative papers, contribution of major collaborative partner countries, contribution of various subject-fields, contribution and impact of most productive institutions and authors, media of communication and characteristics of high cited papers. They conclude that India needs to increase both the quantity and quality of research and also increase the international collaborative research, besides strengthening and modernizing its research infrastructure. There is need to treat schizophrenia as a priority area in the current and future national S & T plans of India.

Alhaider, I., Ahmed, M. K. K., & Gupta, B. M. (2013) have analysed the global research output related to date palm based on a fact of its large consumption and production in Middle East. They analyzed 1,376 papers obtained from SCOPUS database for the period of 2000-11. They examined major productive countries and their citation impact and also analyzed inter-collaborative linkages, national priorities of date palm
research, besides analyzing the characteristics of its high productivity institutions, authors and journal.

Serenko, A., & Bontis, N. (2013) have studied to update a global ranking of knowledge management and intellectual capital (KM/IC) academic journals. 379 active KM/IC researchers; and the journal citation impact method. Scores produced by the application of these methods were combined to develop the final ranking. Twenty-five KM/IC-centric journals were identified and ranked. Knowledge Management Research & Practice has substantially improved its reputation. The Learning Organization and Journal of Intellectual Capital retained their previous positions due to their strong citation impact. This demonstrates that KM/IC is not a scientific fad; instead, the discipline is progressing towards academic maturity and recognition. The developed ranking may be used by various stakeholders, including journal editors, publishers, reviewers, researchers, new scholars, students, policymakers, university administrators, librarians and practitioners. It is a useful tool to further promote the KM/IC discipline and develop its unique identity.

Nourmohammadi, H. (2013) has explained the essential for the research policy makers to acquire knowledge about the global ranks of their countries in in Pathology and Forensic Medicine subject areas, scientometrics experts have been always ranking and analyzing countries on the basis of 'total number of papers', 'total number of citations' and 'citations per paper', etc. Materials and Methods: The data in SCImago has been used to analyze and evaluate the global ranks of Iran, Turkey, Saudi Arabia, India, Pakistan, South Korea and South Africa. These countries had a similar growth trend in many indicators of science and technology in the past. Results: This article mainly deals with the extent of presence of these countries in Pathology and Forensic Medicine subject areas, their international global ranks and comparing them with each other. Furthermore, data show that these countries had a different situation considering "citations per Document"; because it did not match with their "number of Document" and "total number of citations" to their papers and did not increase accordingly.

Van Bochove, C. A. (2013) has provides scientometricians with a brief overview of the history of economic statistics and its international standards. Part of the latter is the Frascati family of standards in science and technology input statistics. Some
recommendations are given for improvements in these standards. Proposals are developed to relate research inputs as defined in the Frascati manual and bibliometrically measured outputs.

Fu, H., Wang, M., & Ho, Y. (2013) have discussed about a bibliometric analysis based on the Science Citation Index Expanded from the Web of Science was carried out to provide insights into research activities and tendencies of the global drinking water from 1992 to 2011. Study emphases included performance of publication covering annual outputs, mainstream journals, Web of Science categories, leading countries, institutions, research tendencies and hotspots. The results indicated that annual output of the related scientific articles increased steadily. Water Research, Environmental Science & Technology, and Journal American Water Works Association were the three most common journals in drinking water research. The USA took a leading position out of 168 countries/territories, followed by Japan and Germany. Ozonation and chlorination in disinfection, and adsorption were common techniques and are getting popular. Commonly researched drinking water contaminants concerned arsenic, nitrate, fluoride, lead, and cadmium, and pharmaceuticals emerged as the frequently studied contaminants in recent years. Disease caused by contaminants strongly promoted the development of related research.

Lancho-Barrantes, B. S., Guerrero-Bote, V. P., & De Moya-Anegón, F. (2013) has explained the International collaboration enhances citation impact. Some collaborating countries provide greater increments in this sense than others, and likewise some countries receive greater increments from their partner countries than others. The authors observed a certain tendency for these increments to be lower in countries with greater impacts. Also, all the countries studied had higher Domestic Impacts as a result of collaborating, although this increment was less than that obtained from other countries. Finally, there were differences in the behavior of the countries between the various scientific disciplines, with the effects being greatest in Social Sciences, followed by Engineering.
Wang, L., Wang, Q., Zhang, X., Cai, W., & Sun, X. (2013) have studied a bibliometric approach in identifying global research trends related to the anaerobic digestion of biomass for methane production using related literature in the Science Citation Index Expanded database, retrieved from the ISI Web of Science. The data used covers the period 1994-2011. The articles acquired from such literature were concentrated on the general analysis by scientific output, research performances by countries, institutes, and collaborations, and research trends by the frequency of author keywords, words in title, words in abstract, and 'KeyWords plus'. The research outputs of anaerobic digestion for methane notably increased in the field of environmental sciences, biotechnology and applied microbiology, environmental engineering, energy and fuels, and microbiology, while increased slightly in water resources. The USA with most publications and China with the highest growth rate were compared. Finally, author keywords, words in title and 'KeyWords plus' were analyzed contrastively, with the recent hotspots provided.

Konur, O. (2013) have explored the characteristics of the literature on the attitudes toward their disabled people published during the last three decades, based on the databases of Science Citation Index-Expanded (SCIE) and Social Sciences Citation Index (SSCI) and its implications using the scientometric techniques. The results of this study reveal that the literature in this field has grown steadily during this period reaching to 655 papers in total with parallel changes in the research landscape. Papers were mostly journal articles, reviews, and proceedings, and being predominantly in English. The US was the most publishing country producing 54% of the output. The "Bar Ilan University" of Israel was the most contributing institution and the most publishing author was "Livneh H". "Rehabilitation Counseling Bulletin" was the most publishing journal whilst "Rehabilitation" was the most published subject area. The total number of citations was 5,262 resulting in 8.03 average citations per paper and "H-index" of 29. "Donaldson J" had the highest impact on the literature. The results of this first ever such study of its kind showed that the scientometric analysis has a great potential to gain valuable insights into the evolution of the research on the attitudes toward disabled people.
Erfanmanesh, M., Rohani, V. A., & Abrizah, A. (2012) have examined the co-authorship network in the field of scientometrics using social network analysis techniques with the aim of developing an understanding of research collaboration in this scientific community. Using co-authorship data from 3125 articles published in the journal Scientometrics with a time span of more than three decades (1980-2012), the construct an evolving co-authorship network to calculate three centrality measures (closeness, betweenness, and degree) for 3024 authors, 1207 institutions, 68 countries and 22 academic fields in this network. This paper also discusses the usability of centrality measures in author ranking, and suggests that centrality measures can be useful indicators for impact analysis. Findings revealed that scientometrics was not dominated by a couple of key researchers as quite a significant number of popular researchers were identified. The United States occupies the topmost position in all measures except for degree centrality. The most active, central and collaborative academic discipline in scientometrics is Information & Library Science.

Gunasekaran, M., & Balasubramani, R. (2012) have analyzed the artificial intelligence research output carried out during the year 1973 - 2011 the different parameters including authorship pattern, growth, rank with global publication, institutions contribution, most productivity journals were analyzed. Analysis report shows that India ranks at 1st position among the top 17 countries with 219 (96.05%) papers. The Indian research output delivered very slightly decreases in the year 1973 and gradually increased every year. The journal of Expert Systems with Applications is one of the type sets among 147 journals published in the articles.

Manimekalai, A. and N. Amsaveni (2012) have analyzed the growth of research publications and the authorship pattern on Genetics and other related subject has been analyzed for the data taken from the articles listed in Web of Science covering the period 1998 to 2011. The records considered for the study is 871 and the pattern of productivity of various author categories are identified. The total of authors downloaded (4433) papers were divided into different categories, namely all authors, first authors, non-collaborative authors and co-authors. The collaborative publications have shown a systematic increase and the single author seemed to be in a decline in the proportion. Simple probabilistic
distributions were explored for their goodness of fit in the publication data on the number of authors per publication in genetics from India.

**Mani, S and Arun, M (2012)** have been a significant increase in the college seats available in undergraduate engineering degree programmes in Kerala. This has happened by licensing a number of privately-owned engineering colleges. Consequently, enrolment in engineering increased from about 2,800 in 1991 to about 28,000 in 2008. After a careful analysis of a unique data set, this study reaches the conclusion that actual out-turn rates have been steadily declining, especially since 2004. This decline is observed at the aggregate level, across different branches and also across different colleges. It then hypothesizes about the probable causes for this steady decline in out-turn rates and concludes with the larger implications of this state of affairs.

**Prathap, G. (2012)** re-evaluates an example using a "thermodynamic" paradigm to show how bibliometrics can incorporate normalization into the evaluative process. The motivation for this is the recent exchange in the pages of this journal from two groups that have taken different positions on how normalization should be done.

**Wang, F., Qiu, J., & Yu, H. (2012)** have examined citation relationship among authors can be divided into 3 types: co-citation, coupling and cross-citation. Since author co-citation analysis was first introduced in 1982, it has been widely applied to study discipline structure, research state and research trends. Afterwards, conception of author bibliographic-coupling analysis was put forward and related empirical studies provided a method for mapping active authors in a research field for a more realistic picture of the current state of its research activities.

**Khan, G. F., & Park, H. W. (2012)** have stated that the academic scientists and policy-makers in the development and employment of TH (Triple Helix) and WSI (Webometrics, Scientometrics, and Informetrics) research methods. However, the international literature has not systematically examined TH and WSI approaches in an Asian context. Furthermore, previous literature published in international journals does not adequately address the social forces shaping TH development in Asia.
Abbasi and Biglu (2011) have analyzed quality and quantity of scientific productions originated by Iranian medical sciences Universities during 1999-2008. All raw data was extracted from the database of Web of Science during 1999-2008. The findings of study showed that the number of scientific productions emanated by Iranian Medical Sciences Universities has increased through the study period. The number of scientific productions increased from 259 documents in 1999 into 15852 documents in 2008, an increase of greater than 60 times. Articles were the most frequent document type indexed in the WoS. English language was the dominant language of publications. Pharmacology and pharmacy have been the most interesting subject area for researchers in theses universities. Despite fluctuations in the number of received citations in scientific productions and H-index of these universities during study period, the number of self-citations has increased significantly, but in terms of citation average per paper, a descending order was observed during the study decade.

Khan et al., (2011) have founded that e-government literature in developing countries has somewhat adopted a balanced approach and is moving away from a merely theoretical or conceptual bases toward an empirical foundation; however, the literature lacked depth and balance in terms of issues/topics discussed and methodologies applied. In the light of the findings, strengths, limitations, and future directions for e-government research in developing countries are discussed. Utilizing scientometrics approach, we analyzed and synthesized e-government (EG) literature that deals with the issues/topics in developing countries from the lens of socio-technical theory (STT). 145 articles from 7 core e-government journals published during the last decade were selected and reviewed for analyzing e-government literature related to developing countries. The growth pattern of e-government literature showed that e-government studies pertaining developing countries issues/topics have rapidly increased during the last decade; covering a range of topics/issues studied from socio-technical aspects.

Waltman et al., (2011) highlighted the crown indicator is a well-known bibliometric indicator of research performance developed by our institute. The indicator aims to normalize citation counts for differences among fields. They critically examined the theoretical basis of the normalization mechanism applied in the crown indicator. They
also make a comparison with an alternative normalization mechanism. The alternative mechanism turns out to have more satisfactory properties than the mechanism applied in the crown indicator. In particular, the alternative mechanism has a so-called consistency property. The mechanism applied in the crown indicator lacks this important property. As a consequence of our findings, we are currently moving towards a new crown indicator, which relies on the alternative normalization mechanism.

Karpagam, et al. (2011) analyzed the growth pattern of Nanoscience and Nanotechnology literature in India during 1990-2009 (20 years). The Scopus international multidisciplinary bibliographical database was 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, subject profile, etc. 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.

Raja, S. & Balasubramani, R. (2011) analyzed plasmodium falciparum research publication in India measured from Histcite software and other tools. The results show that the growth of Indian literature in plasmodium falciparum deposition and make the quantitative assessment of the research in terms of year-wise research output, geographical distribution, nature of collaboration, characteristics of highly productive institutions and the channel of communication used by the scientists.

Hassanzadeh (2011) has aimed to nurture this idea articulating concept of scientometrics in an organizational context and highlighting role of information science professionals in this process. He has attracted attentions from governments and organizations. Experts dealing with scientometrics and related investigations seek for impacts of working actors of science society on together from personal to governmental levels. Investigations of this kind provide scientific society with knowledge of prolific authors, organizations and countries. Integrating an organizational view with
scientometrics studies will help us to reach in fruitful knowledge on science road map of organizations which finally, will enable better knowledge management.

**Bjurström and Polk (2011)** have demonstrated that IPCC Third Assessment Report is strongly dominated by Natural sciences, especially the Earth sciences. The Social sciences are dominated by Economics. The IPCC assessment also results in the separation of the Earth, Biological and Social sciences. The integration that occurs is mainly between closely related scientific fields. The research community consequently imposes a physical and economic bias and a separation of scientific fields that the IPCC reproduces in the policy sphere. It is argued that this physical and economic bias distorts a comprehensive understanding of climate change and that the weak integration of scientific fields hinders climate change from being fully addressed as an integral environmental and social problem. If climate change is to be understood, evaluated and responded to in its fullness, the IPCC must broaden its knowledge base and challenge the anthropocentric worldview that places humans outside of nature.

**Zheng, Yanning et al. (2011)** have revealed that the citation count is an indication of the influence of specific articles. The importance of citations means that it is valuable to analyze the articles that are cited the most. This research investigates highly-cited articles in physics (1979-2008) using citation data from the ISI Web of Science. In this study, 1544205 articles were examined. The objective of the analysis was to identify and list the highly-productive countries, institutions, authors, and fields in physics. Based on the analysis, it was found that the USA is the world leader in physics, and Japan has maintained the highest growth rate in physics research since 1990. The study can provide science policy makers with a picture of innovation capability in this field and help them make better decisions. Hopefully, this study will stimulate useful discussion among scientists and research managers about future research directions.

**Choi, Kyeyoun et al. (2011)** have investigated research trends on smart textile and clothing and to suggest future research directions on smart textile and clothing by using scientometrics approach. The research of smart clothing was divided into five categories: technology, human factors, application, manufacturing, and consumer
demands and retailing. Technology emerged as the dominant category suggesting technological development of smart materials and wearable input devices have been intensively studied and have provided a solid foundation for smart clothing research. The number of research on output devices and data and power transportation showed a gradually increasing trend since 2000. Analysis on technical collaboration among each research field showed a high correlation between input technology and the three main categories: smart materials, functional application and, manufacturing. Material sciences, electronic engineering and computer sciences were shown to be major research disciplines to lead smart clothing research based on quantity of publications.

Builova and Osipov (2011) have briefed information and analytical survey of the papers that were submitted to the Third International Nanotechnology Forum that was held in Moscow on November 1-3, 2010. Scientometric data on the participants, their origins by region and research center, as well as an analysis of the achievements and problems of Russian research on nanotechnologies, are given.

Poornima et al. (2011) have analyzed of 1060 publications published by Indian scientists during 1998 to 2010 and indexed by Web of Science online Database indicates that the publication output in the Indian Research Publication. Centre Food Technology Research Institute, BARC, Indian Institute of Technology, Defense Food Research Lab and institutes are the major producers of research output. Most of the prolific authors are from the highly productive institutions. This work is to provide a profile of research in Indian Research Publication in India. This includes tracking the number of papers, scatter of papers over journals, and its effect on publication output, authors’ institutional affiliations and authorship patterns.

Konur and Ozcan (2011) have 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. Most of document type 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.

Surulinathi et al. (2011) have analyzed the Indian literature output scanned in Web of Science during 1999-2011 on solar energy research indicates that the growth of the literature. The area of solar fuels and Material sciences multidisciplinary has received maximum attention. Publication output of literature by different countries collaboration follows the trend in basic sciences with USA and South Korea being the major producers with India. The contribution of Indian Institutions and Global Citation Scores, h-index, g-index and gh-index has been analyzed.

Si, and Linbo (2010) have carried on the statistical analysis to the published papers, column set, author and citation of Tsinghua Journal of Education (2007-2008) through applying the method of scientometrics, and makes the appraisal of its publication characteristic and academic influence accordingly.

Srinivasa Ragavan, S et al. (2010) analysed the Publication pattern of Harvard Business Review (HBR) from 1999-2010. It is a premier periodical in Business and Management published from Harvard Business School, Boston. United States. The study is based on the 3329 Research Articles which received 8167 Global Citation Scores during the study period. The Source of the study is the internationally known and highly used and authentic database, Web of Science. The paper illustrates Authorship pattern, Growth of publications, source-wise distribution, institutions wise distribution, and h-index based on the analysis of the data. The country wise analysis reveals USA as major contributors with 47.40% of total literature.

Builova and Osipov (2010) have briefed information and analytical survey of the papers submitted to the Second International Nanotechnology Forum held in Moscow in October 2009. Scientometric data on the participants, their origins by regions and research centers, as well as an analysis of the advancements and problems of Russian research in nanotechnologies, are given.
Li and Hou (2010) have reviewed the changes of 5 Finance and Economics universities based on the analysis of a series of scientometric indicators. The following indicators are calculated for each university: Peer Review, the quality of research output, the quality of academic staff, foreign content and faculty/student ratio. The result of ranking of 5 Finance and Economics universities shows that although the method provided in this paper is considered inherently controversial for not being absolutely objective, they are still used as reference to assist in making certain crucial decisions for many research institutions and government funding agencies.

Guns and Liu (2010) have investigated scientific collaborations in China in the context of international collaboration on the basis of a co-authorship network (in the field of scientometrics), using Q-measures as indicators of internationalization in collaboration. The results show that a relatively small group of Chinese researchers is internationally active, and that most of them mainly form bridges between China and other countries. There is a clear dominance of three institutes, viz. ISTIC, Dalian University of Technology, and Henan Normal university. The main domestic broker for China is Liang Liming, whereas the main foreign broker for China is Ronald Rousseau. A small amount of international collaborations takes place outside the largest component of the network.

Surulinathi M, et al. (2010) analyzed research publication performance of Wi-Fi Communication research literature is an important aspect of the content and meaning of the present study. Scientometric studies are used to identify the pattern of publications, authorship, citation and secondary journals coverage in the hope that such regularities can give and insight into the dynamics of under consideration.

Vinkler (2010) has determined the eminence of scientific journals, a new indicator stressing the importance of papers in the "elite set" (i. e., highly cited papers) is suggested. The number of papers in the elite set \(P_{\pi v}\) is calculated with the equation: \((10 \log P) - 10\), where \(P\) is the total number of papers in the set. The one-hundredth of citations \(C\) obtained by \(P_{\pi v}\) papers regarded as the \(\pi_v\)-index which is field and time dependent. The \(\pi_v\)-index is closely correlated with the citedness \((C/P)\) of \(P_{\pi v}\) papers, and
it is also correlated with the Hirsch-index. Three types of Hirsch-sets are distinguished, depending on the relation of the number of citations received by the Hirsch-paper (ranked as h) and the paper next in rank (h + 1) by citation. The h-index of an Anomalous Hirsch-set (AH) may be increased by a single citation to a paper outside the Hirsch-core. (A set of papers may be regarded as AH, where the number of citations to the Hirsch-paper is higher than the h-index and the next paper in rank shows as many citations as the value of the h-index.).

**Opthof and Leydesdorff (2010)** have highlighted the Center for Science and Technology Studies at Leiden University advocates the use of specific normalizations for assessing research performance with reference to a world average. The Journal Citation Score (JCS) and Field Citation Score (FCS) are averaged for the research group or individual researcher under study, and then these values are used as denominators of the (mean) Citations per publication (CPP). Thus, this normalization is based on dividing two averages. This procedure only generates a legitimate indicator in the case of underlying normal distributions. Given the skewed distributions under study, one should average the observed versus expected values which are to be divided first for each publication. We show the effects of the Leiden normalization for a recent evaluation where we happened to have access to the underlying data.

**Yang (2010)** has used the Web of Science this article researched recent developments and changes in the Scientometrics by bibliometrics analysis of articles, proceedings papers, letters and reviews published in the journal Scientometrics during 2000 to 2010 and the citation to these papers. The research indicates that Scientometrics is in the active stage of development in recent years. The United States, Spain, Belgium and China are the most active countries in the field of Scientometrics. The study also identified the most active research institutes, researchers, and subject areas the Scientometrics applied to.

**Sheeja, N. K. (2010)** has conducted to investigate research scholars' perceptions of the information sources, services and infrastructures in university libraries in Kerala. A survey questionnaire was sent to research scholars working in four universities. The study revealed that the organization of resources and services in university libraries is not
fully oriented towards supporting the process of research, and scholars were not satisfied with existing primary resources and personalized services. The study provides recommendations to enhance research-oriented library resources and services.

**Vinkler (2009)** has highlighted the several simple and sophisticated scientometric indicators generally applied in the literature (e.g. total number of publications and citations, citations per journal paper, relative cited indexes, Hirsch index, etc.), which may characterize the publications of scientists both qualitatively and quantitatively. The calculation methods generally use data referring to the total set of papers studied. Scientific progress, however, may be attributed primarily to information in the highly cited publications. Therefore, a new indicator ($\pi$-index) is suggested for comparative assessment of scientists active in similar subject fields. The $\pi$-index is equal to one hundredth of the number of citations obtained to the top square root of the total number of journal papers (elite set of papers) ranked by the decreasing number of citations.

**Suluimanov, Frolova and Khasenova (2009)** have analyzed the results of the scientometric analysis of foreign publications by Kazakh authors that was reflected in the SCOPUS DB 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.

**Jacsó (2009)** discussed the results of recent experiments in calculating the h-index and other bibliometric and scientometric indicators from Google Scholar with the Publish or Perish software. It is found that PoP allows the user to edit the result lists presented in a compact, efficient grid-format. It facilitates the identification and removal of duplicate entries by offering dynamic sorting of the set by eight metadata elements, un-checking items and instant recalculation of the indicators. It is also suggested that the
option to upload into PoP the result lists produced in CSV format from Web of Science and Scopus (which have much more reliable and reproducible data than Google Scholar) should also be offered.

Garfield (2009) highlighted while ISSI was founded in 1993, Scientometrics and Bibliometrics are now at least half a century old. Indeed, the field can be traced to early quantitative studies in the early 20th century. In the 1930s, it evolved to the "science of science." The publication of J.D. Bernal's Social Function of Science in 1939 was a key transition point but the field lay dormant until after World War II, when D.J.D. Price's books Science. Since Babylon and Little Science, Big Science was published in 1961 and 1963. His role as the "Father of Scientometrics" is clearly evident by using the HistCite software to visualize his impact as well as the subsequent impact of the journal Scientometrics on the growth of the field. The timeline for the evolution of Scientometrics is demonstrated by a HistCite tabulation of the ranked citation index of the 100,000 references cited in the 3000 papers citing Price.

Ying, H. (2009) has described a method that can solve the selection problem of peer review experts - scientometrics. From the external part of the scientific community, we can deal with the expert selection of peer review that is the internal part of the scientific community in essence. Only the scientific selection of peer review experts can guarantee the scientific evaluation of the objectiveness, impartiality and fairness.

Trimble (2009) reviewed that Counting papers and citations is one way to estimate the significance of particular astronomical telescopes and other facilities in the long time gap between the verdict of history and the referee's report on your most recent proposal. This has been done for 2,184 observational astronomy papers published between 1960 and 1964 (with 14,237 citations in 1965-1969) and the numbers looked at in various ways. The extreme dominance of California in optical astronomy and of the UK and Australia in radio astronomy provides the background against which ESO, NOAO, NRAO, and A&A were founded, with equality of access to facilities having increased enormously in the intervening 40 years, but inequality of results having
increased slightly. A number of other factoids about astronomical publications, the community, and their environments surfaced during the counting process.

**Sebastain, A (2008)** analyzed in higher education in Kerala, the paper examines the impact of this growth on the gender gap in labour market outcomes of graduates in terms of work participation and unemployment. The paper shows that a rise in higher education has led to an increase in unemployment among women along with an increase in their work participation. It examines the role of job preference, gender segregation of occupation and labour force turnover in determining the unemployment level. The analysis suggests that inter-labour force mobility accounts for most of the increase in unemployment among higher educated women. There are distinct job preference between higher educated women and men. While women are found to have high preference for teaching and clerical jobs, men are employed in a wide range of occupations. This skewed job preference among women strengthens gender segregation of labour market, which adversely affects their employment prospects. High levels of female unemployment and the persistence of a gendered work structure have limited the scope of increasing female higher education being translated into higher participation in economic activity.

**Hou, Kretschmer and Liu (2008)** have explained the structure of scientific collaboration networks in scientometrics is investigated at the level of individuals by using bibliographic data of all papers published in the international journal Scientometrics retrieved from the Science Citation Index (SCI) of the years 1978-2004. Combined analysis of social network analysis (SNA), co-occurrence analysis, cluster analysis and frequency analysis of words is explored to reveal: (1) The microstructure of the collaboration network on scientists' aspects of scientometrics; (2) The major collaborative fields of the whole network and of different collaborative sub-networks; (3) The collaborative center of the collaboration network in scientometrics.

**Kademani et al. (2008)** attempted to analyze 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. 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.

**Sangam, Kiran Savanur and Manjunath (2007)** emphasised on Ramaseshan scientific contributions in various journals and some classic papers. In his entire career as a scientist he has collaborated with 47 eminent scientists and students and has published a total of 178 papers during the years 1944–2000. His field of interest has been varied and thus classified into 4 main area, i.e. Crystallographic studies, Magneto-optics & Optics, Solid State Physics and Miscellaneous topics. S. Ramaseshan has contributed for the better understanding of various subjects in which he specialized during his years at the Indian Institute of Science, University of Madras and the Raman Research Institute.

**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 have been interrogated for the identification of South African authors publishing in the field. The article identifies trends over time, major institutional contributors, journals in which South African authors publish their research, international collaborators and performance in comparison to four comparator countries (India, Brazil, South Korea and Australia). 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.
Vinkler and Peter (2007) indicated that calculating scientometric indexes for individuals, self-citations should be excluded and the effect of the different bibliometric features of the field should be taken into account. Scientometrics cannot offer a simple consistent method for measuring the scientific eminence of individuals. The h-index method introduced by Hirsch was found applicable for evaluating publications of senior scientists with similar publishing features, only. The correctness of the indexes used for evaluating journal papers of individuals should be investigated also on the individual level. Some simple methods using the number of citations and journal papers, and the number of citations obtained by the most frequently cited papers are suggested and tested to demonstrate the advantages and disadvantages of such indexes.

Kademani et al. (2007) attempted to analyze the growth and development of science and technology (S&T) activities in India, as reflected in publication output covered by Science Citation Index (SCI) during 1990-2004. The Indian scientists published a total of 1,82,111 papers in SCI covered journals during the above period. The present study analyses the broad features of Indian S&T by focusing on its publication growth characteristics, language, format and media of communication, research quality, institutional productivity, patterns of research collaboration, and broad and narrow subject areas of interests of Indian institutions and scientists. A broad comparison of India's research output with select countries, particularly with China, has also been made.

Cheng and Liu (2006) highlighted the top 500 world universities are classified into 21 types according to their disciplinary characteristics using clustering method. The indicators used to represent the disciplinary characteristics of an institution are the proportion of publications in six broader disciplinary areas: Arts/Humanities & Social Sciences, Natural Sciences & Mathematics, Engineering/Technology & Computer Sciences, Life Sciences, Clinical Medicine, and Interdisciplinary & Multidisciplinary Sciences. Institutions have been classified into types of having focus in a disciplinary group, having priority in a disciplinary group, having orientation in a disciplinary group, and balanced. The distribution of different types of institutions with respect to countries and ranks are analyzed.
**Jucher, Schlögl and Stock (2006)** reviewed the dimensions of the scientometrics of journals are (1st) journal production (articles, authors), (2nd) journal content,(3rd) journal reception(readers), (4th) formal scholarly communication (references, citations), (5th) journal editing (editorial politics, publication). The journal "BuB - forum für Bibliothek und Information "(BuB) is analyzed scientometrically. BuB is the library and information studies journal with the highest circulation in German speaking countries. 4,297 journal articles including 6,803 references from the observation period 1990 to 2003 were taken into consideration. Though men and women each produce exactly 50% of all articles, there are gender-specific differences: male authors produce more literature reviews and long articles, female authors write more short articles and conference reports. The references' half-life is with 2.7 years very low, the half-life of cited monographs is higher than that of cited journal articles.

**McKiernan (2005)** described the bibliometrics is traditionally associated with the quantitative measure of documentary materials and embraces all studies which seek to quantify the process of written communication. These include science studies, research evaluation, knowledge management, environmental scanning, trend analysis, and the optimization of library and information resources. Significant Web resources relating to bibliometrics and related approaches are now available.

**Kumar and Garg (2005)** analyzed 2058 papers published by Chinese authors and 2678 papers published by Indian authors in the field of computer science during 1971-2000 indicates that India's output is significantly higher than the Chinese output. However, China is catching up fast. Chinese researchers prefer to publish their research results in domestic journals, while Indian researchers prefer to publish their research results in journals published in the advanced countries of the West. Also the share of papers in journals covered by SCI for India was higher than from China. However, no significant difference has been observed in the impact of the research output of the two countries as seen by different impact indicators. Team research is more common in India as compared to China.
Uzun (2004) reported the findings from a study of patterns of foreign authorship of articles, and international composition of journal editorial boards in five leading journals in the field of information science, and scientometrics. The study covered an American journal and four European journals. Bibliographic data about foreign authors and their national affiliation from five selected years of publication were analyzed for all journals. The foreign input of article was extremely high in Information Processing & Management, and Scientometrics, and was relatively low in the other three journals. The number of foreign countries contributing in all journals has increased rapidly since 1996. Canada, England, Belgium, Netherlands, China, and Spain were the countries with high contributions in JASIST. The authors from the USA have dominated the foreign-authored articles in all European journals. A simple linear regression analysis showed that 60% of variation in the proportion of foreign-authored articles in the set of five journals over the selected years could be explained by the percentage of foreign members on the editorial boards of the journals.

Bharvi, Garg and Bali, A (2003) analyzed 1317 papers published in first fifty volumes during 1978 to 2001 of the international journal Scientometrics indicates the heterogeneity of the field with emphasis on scientometric assessment. The study indicates that the US share of papers is constantly on the decline while that of the Netherlands, India, France and Japan is on the rise. The research output is highly scattered as indicated by the average number of papers per institution. The scientometric output is dominated by single author’s paper; however multi-authored papers are gaining momentum. Similar pattern has been observed for domestic and international collaboration.

Chen, et al. (2002) investigated an integrated approach to scientometric studies with emphasis to the use of information visualization and animation techniques. This study drawn upon citation and co-citation patterns derived from articles published in the journal Scientometrics (1981–2001). The modeling and visualization takes an evolutionary and historical perspective. The design of the visualization model adapts a virtual landscape metaphor with document co-citation networks as the base map and annual citation rates as the thematic overlay. The growth of citation rates is presented
through an animation sequence of the landscape model. Issues concerning the visual-spatial design are discussed from a citation analysis point of view.

**Garg and Padhi (2002)** analyzed 952 publications published by Indian scientists and abstracted by Journal of Current Laser Abstracts during 1970-1994 indicates that laser research in India picked up during 1978-1994 and reached its peak in 1980. The Indian output in the field of laser research forms an integral part of the mainstream science as reflected by the pattern of publications and their citations in the international literature. Laser research performed in India improved considerably during 1985-1994 as compared to 1970-1984 as seen by different impact indicators such as citation per paper, proportion of high quality papers, and publication effective index. India's citation rate per paper for highly productive authors is at par with the world citation rate per paper. The study indicates that the proportion of mega authored papers increased during 1990-1994 and the international collaboration is mainly with the USA.

**Garg (2002)** analyzed 1223 papers published by India (347papers) and China (876papers) at conferences and in journals during 1993 and 1997 in the field of laser S&T indicates that China’s output was twice to that of India. However, Activity Indices for both the countries in 1993 and 1997 were almost the same. Chinese scientists preferred to publish in domestic journals, while Indian scientists published in foreign journals. Indian papers also got more citations per paper than Chinese papers. Team research appears to be better in China than in India, as reflected by the number of mega-authored papers produced by the two countries.

**Peritz and Bar-Ilan (2002)** have examined the extent to which the field of bibliometrics and scientometrics makes use of sources outside the field. The research was carried out by examining the references of articles published in Scientometrics in the course of two calendar years, 1990, 2000. The results show that in 2000, 56.9% (and 47.3% in 1990) of the references originated from three fields: scientometrics and bibliometrics; library and information science; and the sociology, history and philosophy of science.
**Uzun (2002)** surveyed a set of ten scholarly journals that publish the mainstream of papers in the field of Scientometrics, Informetrics, and Bibliometrics (SIB). The survey is limited only to the research articles published in the field for the two decades period 1981-2000. Each journal was examined issue by issue for the institutional affiliations of contributing authors. Institutional rankings for the total period and the two decade periods; 1981-1990 and 1991-2000 were determined by awarding credit to the authors' institutions based on authorship. In the composite of ten journals, the University Sheffield (England), the University of North Carolina (USA), the University of Leiden (Netherlands), the City University of London (England), the National Institute of Science, Technology and Development Studies (India), the University of Sussex (England), the University of Illinois (USA), the University of Michigan (USA), the Hungarian Academy of Sciences Library (Hungary), and Indiana University (USA) emerged as the ten most productive institutions for the period 1981-2000.

**Ivancheva (2001)** has attempted made to give an answer to the question: Why do most bibliometric and scientometric laws reveal characters of Non-Gaussian distributions, i.e., have unduly long "tails"? We tried to apply the approach of the so-called "Universal Law," discovered by G. Stankov (1997, 1998). The basic principle we have used here is that of the reciprocity of energy and space. A new "wave concept" of scientific information has been propounded, in which terms the well-known bibliometric and scientometric distributions find a rather satisfactory explanation. One of the made corollaries is that $\alpha = 1$ is the most reasonable value for the family of Zipf laws, applied to information or social phenomena.

**Granovsky (2001)** has devoted to the scientometric research of Professor V.V. Nalimov (1910-1997) of Moscow State University. His first scientometric article was published in 1959: mathematical models of world science growth were examined and logical grounds for the applicability of these models were also given. In his further works, V.V. Nalimov continued to stress the importance of quantitative studies of science development. In 1969, the monograph on scientometrics by V. V. Nalimov and his co-author Z. M. Mulchenko was published. This book reflected his earlier publications on
scientometrics and the solutions of new tasks. In 1970, Nalimov published articles on the comparison of science and the biosphere, the geographic distribution of scientific information, and changes in the demand of scientific staff. In later articles in philosophy of science, he stressed the necessity of a combination of the scientometric approach with works on the logic of science development. One of the latest works by Nalimov was an analysis of articles published by The Journal of Transpersonal Psychology: Here the scientometric approach was used to study the origin and development of a new scientific branch.

Vinkler (2000) reviewed that the evaluation of real scientometric systems needs compromises among the parties interested and between the practical applicability and the theoretical requirements of scientometrics. In the Chemical Research Center of the Hungarian Academy of Sciences, special scientometric indicators have been used for evaluating publication activity of research teams for about 30 years. Modified Garfield impact factors for journals as well as relative citedness of papers are applied as indicators because of differences among subfields in scientometric features of the publications assessed.

Jansz (2000) revealed in 1988 Le Pair postulated the existence of a citation gap for technological research. Several cases were studied, which confirmed his hypothesis. In the same period the use of bibliometric indicators for policy purposes increased. Here we saw the citation gap causing a disadvantage for application-oriented research groups. This is not merely an injustice; it also leads to suboptimum use of available funds, to the detriment of science as a whole. In addition, it may, in the long term, undermine the reputation of scientometrics as a science in its own right.

Garg and Padhi (2000) analyzed of 766 publications by prolific authors in scientific journals indicate that prolific authors produce about 25% of the total scientific output in periodical literature in laser science and technology. The average productivity per author is about 2. Prolific authors from most of the countries belonged either to academic or research institutions except in USA and Japan. Prolific authors on average
made more impact than non-prolific authors. However the situation varied from country to country.

**Karki and Garg (1999)** attempted to assess the performance of Indian organic chemistry research during the 70s and 80s. Identifies the significant work and its impact using mainstream connectivity, surrogate measures of quality and relative impact indicators. It is observed that the organic chemistry research performed in India during the later period (80s) has improved slightly as compared to the previous period (70s).

**Garg and Padhi (1999)** analyzed 4650 publications abstracted in Journal of Current Laser Abstracts Vol. 27 (April 1990-March 1991) indicates that 14 countries contributed about 94% of the research output with USA top of the list followed by Japan and the erstwhile USSR. Technical reports and patents, besides articles in scientific journals constitute an important source of information on laser science and technology. "Spectroscopy of laser output" is the sub-specialty which has received maximum emphasis. USA has paid almost equal emphasis for theoretical, experimental and applications of laser research, while such pattern is not applicable for other countries. For USSR, China, and India, the impact of research did not commensurate with the publication effort.

**Cunningham (1997)** presented the results of an examination of a selection of published European evaluations. The incidence of quantitative and scientometric approaches has been reviewed and an assessment made of their contributory role in each evaluation. The various approaches have been broadly categorized according to the type of data they draw upon, and by the issues they attempt to address. The author analyses such approaches with regard to the degree of success in meeting the objectives of the evaluation. In the light of this some likely future trends are suggested.

**Van Raan (1997)** argued that the core research activities of Scientometrics fall in four interrelated areas: science and technology indicators, information systems on science and technology, the interaction between science and technology, and cognitive as well as socio-organizational structures in science and technology. The investigator emphasized
that an essential condition for the healthy development of the field is a careful balance between application and basic work, in which the applied side is the driving force. In other words: scientometrics is primarily a field of applied science. These aspects also contribute substantially to the reputation of scientometrics as a research field respected by the broader scientific community. And this latter point is important; both to let quantitative studies of science and technology take more advantage of an academic environment, as well as to keep it innovative and thus attractive in terms of applications at the longer term.

Haiqi and Yuhua (1997) surveyed based on the data recorded in the Science Citation Index (SCI) database between 1987 and 1993, is to study the research performance in the People's Republic of China. The 35,087 papers published in domestic or foreign periodicals were selected for analysis and evaluation of the distribution of publications and citations, for the numerical characterization of research performance in China. The findings indicate that 17,687 papers covered by the Source Indexes of the SCI in the period 1990-1992 had received 7944 citations in the year 1993 and that the mean citation rate is 0.45. The number of cited papers is 4491 and the proportion of cited papers to the total is 0.25. Research performance in China has increased appreciably during the past few years, both in regard to relative output of publications and in their impact on the international research productivity.

Subbiah Arunachalam and Singh (1985) highlighted the prolific institutions and authors have been identified as well as journals most often used, highly cited papers, etc. Many of the papers appeared in high impact international journals, with Physical Review B (26), Journal of Low Temperature Physics (11) and Solid State Communications (10) leading the field. Among the five institutions active in the area, Tel Aviv University (68) accounts for more than half of Israel's publication output. Hebrew University (32) and Technion Institute of Technology (22) are the other major centers of research in superconductivity. Israeli papers in superconductivity seem to belong to the mainstream literature in the area as seen from their decent citation record, which is better than that of Canada and almost close to that of the USA.
2.3 INFERENCES

From the foregoing review of literature, the following inferences could be drawn:

- The early research studies were analyzed in the field of how to organize the information.
- The research tends to be individual and collaborative author scientific discipline in the area of scientometrics analysis.
- The studies are mostly concentrated on data drawn from databases, individual journals; individual countries research output in a particular field of knowledge, individual subject's world output, individual author's publications, etc.
- The analysis of the studies further reveals the applications of statistical techniques and tools and the generation of a number of formulas and equations that facilitate future researchers to test.
- The sophisticated and highly mathematical analysis of data is made possible by the bibliometricians due to the availability of software packages such as Histcite software, SPSS, and MS Excel so on.

Therefore the investigator has chosen Scientometrics as the subject field and analyzed the productivity of Aquaculture covered in the SCOPUS database.
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