CHAPTER VI
FINDINGS, SUGGESTIONS AND CONCLUSION

The bibliometric studies are frequently used to assess research performance and to generate information that can be used by policy makers and experts. This study has proven to be a useful tool in the assessment of research performance of faculty members. Taking into account the faculty members participation in scientific collaboration as expressed in co-publication the output and productivity have been calculated. In a quantitative approach ranking of universities based on different research performance have been compared. The present study illustrates with facts and figures on the scientific performance of faculty members in the universities of Tamil Nadu.

The wider application of bibliometric techniques is leading to the development of a new and more precise technique hopefully, the ongoing theorist work will point the way to more innovative techniques. Moreover the present study mirrors the actual
published results of the work of faculty members in the universities of Tamil Nadu.

6.1 FINDINGS

The findings of the present study lead to the following observations:

The findings of year-wise distribution of total research output of Tamil Nadu Universities brings out the fact that the scientific publication output by universities is with the pace of gradual growth trend during the study period. Yet the decreasing trend is observed in the year 2001. The study has examined totally 5051 research output for the span of 12 years.

The findings of relative growth rate and doubling time for research output of Tamil Nadu universities reveals the following facts:

The analysis of the growth of science literature by universities reveals that the relative growth rates of research output have shown a declining trend; contrastingly the doubling times for publications have increased remarkably.
The findings of year-wise distribution of total research output vs total research pages convey the following facts:

The growth of total research output is increasing steadily, which is accounted from 278 to 546 over the study period. Yet the number of pages have not shown increasing on par with the output growth rate. The average number of pages per contribution supports the above fact that it constantly maintains at the level of 6.55 per cent.

The findings of relative growth rate and doubling time for total research output pages reveal the following facts:

The relative growth rate for the total research output of pages has shown a decreasing trend. Even if more number of pages have been published over the years, the rate of multiplication is not uniform during the periods of examination. It has been highlighted from the doubling times for pages which is in increasing trend.

The findings of university wise total scientific research output and year-wise distribution of scientific output bring out following facts:

University of Madras shares the highest per cent of research output performance over the study period. The other ranked
universities are Anna university, with 21.70 per cent, Madurai kamaraj university with 15.87 percent, Bharathidasan university with 9.38 per cent, Bharathiyar University with 8.12 per cent and Annamalai University with 7.87 per cent of research output over the study period. The least per cent of research productivity is given by Avinashilingam deemed university and it has shown the higher level of variation of 243.75 per cent in the level of output performance.

The findings of department wise scientific research output throw a light on the following facts:

The school of chemistry, the school of Zoology and Faculty of Medical Sciences functioning in the University of Madras have published more number of publications in the respective discipline and their performance is highly appreciated. Anna university is considered to be toper since its school of Physics, Faculty of Engineering and school of Mathematics have published largest number of publication than the departments of other universities in the same field, whereas school of Biological sciences of Madurai Kamaraj university is topper in publishing more number of publication than other universities in this discipline. The faculty of agriculture functioning in Tamil Nadu agricultural university is placed to top in the discipline of agriculture.
The findings of form-wise distribution of universities research output leads to the following facts:

Out of various forms the articles appeared in the journals rank first in order. It is due to the reason that the majority of faculty members of Tamil Nadu universities intend to publish the research papers in the form of articles which is regarded to have a great level of significance and dissemination effected through out the globe than other sources. The other preferred sources among the Faculty Members are notes, litters and reviews.

The findings of year wise distribution of journal articles reveal the following facts:

University of Madras, Anna University and Madurai Kamaraj University have shown better performance in publishing more number of research articles in Journals. An average performance in article publication is shown by three universities namely Bharathidasan, Bharathiyar and Annamalai. The least performance of article output is given by Mononmaniam Sundaranar University, TNV ASU and GRI. The article output performance by Avinashilingam university is not reported in almost all the years.
The findings of relative growth rate and doubling time for journals articles convey the following facts:

The mean relative growth rate of journal articles output has shown a declining trend consequently mean doubling time has increased.

The findings of year-wise distribution of total research output pages V s total journal article pages reveals the following facts:

Among the total research output pages, journal article pages occupy at the predominant level, it is calculated to 93.38 per cent. The other forms of publications have less number of pages which is accounted to 6.62 per cent.

The findings of relative growth rate and doubling time for pages of journal articles throw a light on the following facts:

The relative growth rate for pages of journal article has shown a decreasing trend. There have been more number of pages recorded over the years yet the rate of multiplication remains uniform during the periods of examination, which is highlighted increasing trend form the doubling time for publications.
The findings of comparative analysis of total research output pages Vs total journal article output pages convey the following facts:

The total journal article contribution occupies the three fourth of the total research output, yet the pages per article contribution show a higher level of growth than that of average pages of total contribution.

The findings of national scientific output Vs total Tamil Nadu State scientific output: An activity index throw a light on the following facts:

Tamil Nadu state's performance show a less percentage on par with national performance in certain years. But the average activity index over the study period 1991 to 2002 shows equivalence that of national average.

The findings of Tamil Nadu state scientific output Vs Tamil Nadu universities scientific output convey the following facts:

The universities play a major role in research and development activities of a state. It is clear from the mean activity index for whole study period which becomes apparent that scientific publication given by Tamil Nadu universities is equivalent to the
whole Tamil Nadu research output on Science and Technology. It is represented as AI>1.

The findings of subject-wise research output of faculty members put forth the following facts:

Among the various subjects of scientific research, chemistry shares the highest per cent (35.34) of research productivity out of the total research output over the study period. Whereas Botany does the least of 3.34 per cent. The highest level of variation in the research output is registered by engineering as 68.12 percent, the less one is by the chemistry as 24.98 per cent. Chemistry and physics are the predominant subjects of research among the faculty members. The other subject areas such as zoology, agriculture share relatively better output comparing remaining areas of subject.

The findings of sub-field-wise scientific research output bring out the following facts:

The highly concentrated subject area of faculty members are chemistry, physics and their sub fields which record 35.71 and 31.52 per cent respectively. Zoology and agriculture have recorded moderate number of publications. They are the other areas of interest among the faculty members. They reflect the output of
10.99 and 5.75 per cent respectively. The less favoured subject fields among the faculty members are mathematics and Botany. They have which recorded less per cent of output 3.74 and 3.34 respectively.

The findings of authorship pattern on scientific literature focus the following facts:

The science research publications brought out by the faculty members of Tamil Nadu universities intend to take collective participation in research and problem solving activities. It has been proved from the study that single authored papers have declining trend and thereby collective contributions have an increasing trend, which is supported by the coefficient variation data 12.80 per cent for two authored contributions where as for single authored contribution it is 38.82 per cent.

The findings of degree of collaboration enlight the following facts; The degree of collaboration has shown an increasing trend from one phase of period to other phase of period. This brings out clearly the high level of prevalence of collaborative research in the field of Science and Technology is found in Tamil Nadu universities.
The findings of single Vs multiple authored output, put forth the following facts:

Among the total science publications of Tamil Nadu universities, multi authored papers dominate with the high per cent of 94.50. The single authored papers are less which reflect the fact that the group activity in research and problem solving activities in the field of Science and Technology is found high.

The findings of author productivity on scientific research output reflect the following facts:

A greater level of research performance is noted among few faculty members. Out of various number of contribution 135 papers is the highest number of contribution which is the productivity of one individual faculty members, Next to which 65 papers, 60 papers and 56 papers and so on. From one paper to 9 paper contribution constitute 94.17 per cent of the total output. The authors who have contributed from more than 10 papers each to the greatest output of 135 papers constitute the remaining less per cent of 5.83 alone. It supports the fact that when the number of published papers increases, the number of contributed authors decreases.
The findings of productivity of authors based on Lotka's law bring out the following facts:

The analysed data regarding author productivity invalidate Lotka's findings. The proportion of all contributions that make a single contribution is less than 60 per cent. Particularly the single paper contributed authors in the present study contribute 55 per cent of the total authors which is nearly calculated to Lotka's value. Further Lotka's chi-square conforms this fact. On the whole the present observation supports the fact that the number of contribution increases, the number of authors decreases.

The findings of distribution of authors according to number of contributions reveal the following facts:

Mr. P. Ramasamy the faculty member of Centre for Crystal Growth of Anna University is ranked in top with 135 different publications on Science and Technology. The second rank is taken by Mr. C. Subramanian of Centre for Crystal Growth Anna University, who has published 65 publications in the field of Science and Technology. The third rank goes to Mr. M. Lakshman Department of Physics, Bharathidasan University, he has published 60 research papers. The high percentage of publication is given by University of Madras. Contrarily while finding the performance of
individual Faculty Member, more number of publication is brought out by the Faculty Members are working in Anna University and Bharathidasan University. The Faculty Member of University of Madras is shifted at 5th place only.

The findings of analysis of authors and their contributions express the following facts:

Relatively 55.37 per cent of Faculty Members have written only one paper, 39.52 per cent of have made between 2 and 10 contributions next to that 3.78 per cent of Faculty Members have published the papers between 11 and 25 each whereas only 1.33 per cent of Faculty Members have alone brought out more than 25 papers each during the study period.

The findings of ranking of individual journals according to output represent the following facts:

There have been 233 higher contributions brought published by Acta Crystallographica Sec-C Crystal Structure Communication of Denmark country. It is ranked at the first position. The second position is taken by current science of India which accounted 231 publications. Totally 6 journals have published more than 100 articles each. The first 18 journals covered 1514 articles; the next
large group of 100 journals published the same number of articles accounted to 1505, the last and vast core of 627 journals have collectively made an equalence of 1499 number of articles.

The findings of Bradford's distribution of journals represents the following facts:

According to Bradford's law of distribution the relationship between the zones is $1:n:n^2$. But the relationship between the zones in the present study is contradictory in each as 18:100:627 which does not fit into Bradford's distribution. It is clear that core distribution of articles are published by a very few journals that leans less than what Bradford's formulated.

The findings of ranking of journals according to Bradford's distribution convey the following facts:

It is a clear indication that less number of journals published more number of papers. Which is meant that core journals highly concentrate in publishing more number of articles. Further the lumber of journals alone increases but the papers covered in this lumber of journals are found less. Finally the maximum number of journals have brought out the least number of papers as output.
The findings of scattering of Articles in Scientific Journals enlight the following facts; that 7.18 per cent of journals covered around 51.71 per cent of the articles, the next 19.06 per cent of journals published only 25.26 per cent of the articles. On the contrary the last and vast core of 72.76 per cent of journals published only 23.03 per cent of the articles. Bradford described this relationship in his study of the scattering of periodicals articles on a given subjects and determined that the distribution of these articles follow a Bradford mathematical mode.

The findings of country-wise distribution of journals reveals the following facts:

The Faculty Members of Tamil Nadu Universities prefer to publishing their research articles in international sources of publications rather than Indian sources. The Indian sources are lagged behind. Among the international sources of publication USA, England, Netherland, Germany, Denmark, Switzerland and Japan are predominant than other countries in publishing Tamil Nadu universities Faculty Member's contributions. Further Austria, Chech republic, Ireland and Singapore have shown a considerable number of publications during the study period.
The findings of Application of Bradford's ranking for the authors contribution put forth the following facts:

About 55 per cent of authors produced only one contribution. Authors who have contributed 2 and more publications are around 45 per cent. In the present study high per cent of authors have produced single contribution therefore the data did not exactly confirm the Bradford's verbal distribution.

The findings Scientific productivity of Authors: Zone Analysis reveal the following facts:

The number of authors increases from one zone to the other zone. But the number of articles published by the authors remain constant. The zone one there are 46 core authors published 1706 articles the multiplier shows that the number of authors alone increases to 2.20 per cent multiplication level. The average multiplier between one zone to other is 2.11 per cent.

It could be seen clearly from the above discussion that the formulated first hypothesis of University of Madras occupies a predominant place in contributing more research output among the universities in Tamil Nadu is identified as validated since the result shows that University of Madras shares the highest per cent of
27.80. In its research output performance than other universities over the study period.

The formulated second hypothesis of the journal source of publication of Science and Technology research output occupies a predominant place while comparing other sources of publications is identified as validated. It is clear from the findings that out of various source forms, the articles appeared in journals rank first in order showing majority of 89.40 per cent of total number of publications reported during the study period.

The formulated third hypothesis of there is a considerable level of inter-universities variation in Science and Technology research output in Tamil Nadu is identified as validated. It is evident from the finding that the university of Madras takes the first position. The second position is recorded by Anna university. Madurai Kamaraj University takes third position in order according to their variation in their level of output.

The formulated fourth hypothesis of there is a significant level of variation in research output performance in various departments of a university is identified validated. It is evident from the findings
that the school of chemistry, school of zoology and Faculty of Medical Sciences functioning in the University of Madras have published more number of publication in the respective discipline then other schools of the same university.

The formulated fifth hypothesis of the relative growth rate of science literature by faculty members shows a declining trend and significantly doubling time for publication explain an increasing trend is proved. It has been confirmed from the findings that the growth rate of total research output by faculty members of universities have shown a declining trend, contrastingly the doubling for publications have increased remarkably.

The formulated sixth hypothesis of the Science and Technology research output of Tamil Nadu universities is equal to the output of whole Tamil Nadu state's is identified as validated. It becomes apparent from the findings that Science and Technology publication given by Tamil Nadu universities is equivalent to the whole Tamil Nadu state's output.

The formulated seventh hypothesis of there is a significant level of variation in research output in various branches of Science
and Technology is identified as validated. It could be seen clearly from the findings of the publications on chemistry record high percent of 35.34 followed by physics with 31.76 percent.

The formulated eighth hypothesis of there has been an increasing trend in collaborative scientific research in recent years is identified as validated. It is a clear indication from the findings that the degree of collaboration shows an increasing trend from D.72 to 0.96 per cent over the study period.

The formulated ninth hypothesis of the implication of Lotka's law is related to author productivity in scientific literature is identified as invalidated. It is evident that the number of single authors contributed paper is less than 60 per cent in the present study.

Formulated tenth hypothesis of the implication of Bradford's distribution is related to journal output of Tamil Nadu Universities is identified invalidated. It is clear from the finding that the relationship between the zone in the present study is contradictory such as 18:100:627 which does not fit in to Bradfords distributions.
The last formulated hypothesis of the science faculty members of Tamil Nadu universities prefer to publish their research articles in Indian journals is identified as invalidated. It is evident that the faculty members have opted for the International Journals especially United States in the first order of priority which shows more than 20 per cent of faculty members' publications over the study period. It is due to international recognition, name and fame, international standard and for international collaboration.
6.2 SUGGESTIONS

The findings of the present study lead to the following suggestive measures:

There are needs to provide more infrastructural facilities in the universities of Tamil Nadu by considering the efficiency of Faculty Members.

The similar suggestion has been given by Garg50 in his study of laser research literature for the contribution of Indian Universities. In which he has suggested to provide improved infrastructure facilities on par to the universities of International standard.

The output among deemed universities is not up to the mark of other universities. Hence, the government should allocate more funds to improve the research activities.

This suggestion is also supported by Jacobs42 in his study that there are significant difference in productivity between areas of sciences and that there is direct relationship between institutional funding and research productivity.

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There is a need to give special training programmes to develop the efficiency and calibre among the Faculty Members of Tamil Nadu universities to pursue their research activities on par with the International standard.

Nagpau124 has also supported the above stated suggestion in his study that research priorities in different countries are influenced more by scientific traditional and national needs than by geographical are socio cultural proximities with other countries. So international standards to be maintained by giving special training programmes.

There is a need to provide incentives and awards to the eminent and outstanding Faculty Members depending on their level contribution to the growth of research and development of the discipline.

Karisdappa in his study suggested that the special training programmes, honours and awards to Faculty Members may tend to increase more number of research activities.
There is a need for intensive concentration of research in various sub-fields and branches of Science and Technology.

There is a need to encourage and motivate a collaborative research activities. In this context Faculty Members of Tamil Nadu universities may be encouraged to undergo collaborative research with the universities of other state and countries.

In order to improve the quality and specialization, the faculty Members should be allowed to undergo special training programmes to developed countries with a view to increase the skill of the Faculty Members.

The Faculty Members should be given more number of project in the subject fields which are lagged behind.

The funding agencies should allocate equal number of projects to all the universities irrespect of demand and request.

The State government should come forward to allocate more funds especially for research activities for all the universities.
6.3 INFERENCES AND CONCLUSION

The research trend in Tamil Nadu Universities is collaborative in nature like any other Scientific Institutions.

Braun22 has also brought out the same research which supports to present inferences that the most of the contributions in nowadays are based- on multiple authorship which is known as collaborative nature.

The researchers by the Faculty Members are found to be increasing and there is a shift from analyzing the research output from macro level to micro level areas.

The studies on bibliometric are mostly concentrated on data drawn from databases, individual journals, individual institutions, research output in a particular field of knowledge, individual subjects research output, individual author's publication and so on. The present study also appears to be a milestone on the above said fact.

Garg K.C50 analysed the publication of various authors who have contributed the bibliometric studies with the data drawn from
databases, individual journals, individual institutions; individual subject research output as well as authors' output and the output in a particular field. He has collectively analysed 174 publications as the above said areas.

The analysis of the present study further reveals the applications of statistical technique and tools and the generation of number of formulas and equations that facilitate future researchers to test. The present study forecasts that the subject of bibliometric is a progressing one not only in measuring the field of Science and Technology but also in other fields.

Moreover, the present study will serve as a beacon light to information seekers.

**Suggestion for further Research Area**

The researcher has done the study in the field of Science and Technology. The researcher further suggests that this type of study may be carried out in Social Science and Humanities in general and any particular field in specific so that one can measure the performance of Faculty Members, output of universities. Core journals, and neglected areas in the respective disciplines.