

A Scientometric Analysis of Aquaculture Literature during 1999 to 2013: Study Based on Scopus Database

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Abstract - An analysis of 106227 publications published by scientist during the time span of 1999 to 2013 and indexed by Scopus Database indicates that the publications output in the Aquaculture Research. Totally 106227 publications; the year of 2013 has the highest number of publications of 13474 (12.68%); in 2012 11822 (11.13%) records were published and in the year 2010 11403 (10.73%) records were found from the Scopus database. The journal articles have dominant place among the eight types of sources. In the percentage analysis, English language (98.26%) dominates in the first place among those thirty languages. Over all continents from 176 different countries have participated on Aquaculture research during from 1999 to 2013. The Europe, North American and Australia have highest specialized relation to the world research output because their SI value is greater than 1. This work is to provide a profile of research in Aquaculture research publications in global level.

Keywords: Scientometrics, Aquaculture, Continents, Specilization Index, Scopus Database.

I. INTRODUCTION

Scientometrics is to provide quantitative characterization of scientific activity; scientometrics is a branch of Library and Information Science. 'Scientometrics' is the branch of Science that described the output traits in terms of organizational research structure, resource inputs and outputs, develops benchmarks to evaluate the quality of information output. Scientometric studies characterize the disciplines using growth pattern and other attributes. In 1969, Vassily V. Nalimov and Z.M. Mulchenko coined the term 'scientometric' ('nalkometriyas') (Nalimov and Mulchenko, 1969). As the name imply, this is the term mainly used for the study of all aspects of the literature of science and technology. The term had gained wide recognition by the foundation in 1978 of scientometrics by Tibor Brawn in Hungary.

II.RELEVANCE OF THE STUDY

It is necessary and useful to review the available literature in order to know the areas that have invited the attention of the research so far, and the areas that seek the attention of the future researchers. Hence, a brief review of related

literature and theories of the study under consideration is presented in this chapter. Zheng, Yanning et al., (2011) has 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. Manimekalai, A. and N. Amsaveni (2012) has 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.

III. DATA AND METHODOLOGY

In order to get an idea about similar studies done in informetrics, an exhaustive literature search was carried out. For this the necessary data were collected from the Scopus database using term of "aquaculture", collecting, organizing and analyzing of data were done on the basis of established informetric / Scientometric methods. The downloaded data was sorted to prepare table and figures using MS-Excel software. This data has downloaded limits the duration of 1999 to 2013 and the major topic of aquaculture.

IV. OBJECTIVES OF THE STUDY

The objectives of the study are as follows.

1. To find out Year Wise distribution of Aquaculture research productivity from 1999-2013.
2. To find out Source wise and Language wise analysis of aquaculture research productivity.
3. To find out overall Continent wise research output of Aquaculture from 1999 to 2013.
4. To find out Specialization Index of Selected Continents research output on Aquaculture.

V. ANALYSIS AND INTERPRETATION

The selected period taken for this analysis of aquaculture research productivity is from 1999-2013 (fifteen years). Totally, 106227 numbers of records were downloaded from the database of Scopus during the sample period in the subject of aquaculture. Among those 106227 publications; the year of 2013 has the highest number of publications of 13474 (12.68 %); in 2012 11822 (11.13%) records were published and in the year 2010 11403 (10.73%) records were found from the Scopus database and the years of 2013, 2012 and 2011 have highest number of publications and it occupied the first, second and third positions among the sample fifteen years.

The year wise assessment reveals that in the year 1999 has 3314 (3.12%) records shared; followed by the year of 2000 when 3426 (3.23%) articles were published in the subject of aquaculture; 2001 when 3802 (3.58%) articles were found; the year of 2002 when 4105 (3.86%) articles in aquaculture; the year of 2003 when 4774 (4.49%) articles were found in aquaculture; the year 2004 when 5011 (4.72%) articles were found the year 2005 when 5489 (5.17%) articles were found the year 2006 when 6760 (6.36%) articles were found the year 2007 when 7256 (6.83%) articles were found; the year 2008 when 7834 (7.37%) articles were found; the year 2009 when 8052 (7.58%) articles were found; the year of 2010 when 9705 (9.14%) articles were found; the year 2011 when 11403 (10.73%) articles were found; the year 2012 when 11822 (11.13%) articles were found and the year 2013 when 13474 (12.68%) articles were found.

Among those 106227 publications; the year of 2013 has the highest number of publications of 13474 (12.68%); in 2012 11822 (11.13%) records were published and in the year 2010 11403 (10.73%) records were found from the Scopus database and the years of 2013, 2012 and 2011 have highest number of publications and it occupied the first, second and third positions among the sample fifteen years.

TABLE I YEAR WISE DISTRIBUTION OF AQUACULTURE RESEARCH PRODUCTIVITY

| S.No. | Year | No. of records | Percentage | Growth Trend | Cumulative Records | Cumulative Percentage |
|-------|-------|----------------|------------|--------------|--------------------|-----------------------|
| 1 | 1999 | 3314 | 3.12 | - | 3314 | 3.12 |
| 2 | 2000 | 3426 | 3.23 | 0.11 | 6740 | 6.35 |
| 3 | 2001 | 3802 | 3.58 | 0.35 | 10542 | 9.92 |
| 4 | 2002 | 4105 | 3.86 | 0.28 | 14647 | 13.79 |
| 5 | 2003 | 4774 | 4.49 | 0.63 | 19421 | 18.28 |
| 6 | 2004 | 5011 | 4.72 | 0.23 | 24432 | 23.0 |
| 7 | 2005 | 5489 | 5.17 | 0.45 | 29921 | 28.17 |
| 8 | 2006 | 6760 | 6.36 | 1.19 | 36681 | 34.53 |
| 9 | 2007 | 7256 | 6.83 | 0.47 | 43937 | 41.36 |
| 10 | 2008 | 7834 | 7.37 | 0.54 | 51771 | 48.74 |
| 11 | 2009 | 8052 | 7.58 | 0.21 | 59823 | 56.32 |
| 12 | 2010 | 9705 | 9.14 | 1.56 | 69528 | 65.45 |
| 13 | 2011 | 11403 | 10.73 | 1.59 | 80931 | 76.19 |
| 14 | 2012 | 11822 | 11.13 | 0.4 | 92753 | 87.32 |
| 15 | 2013 | 13474 | 12.68 | 1.55 | 106227 | 100 |
| | Total | 106227 | 100 | | | |

The analysis of general growth trend in collected data shows that there are variations in the number of publications during the sample period taken for study. The accumulated percentage level indicates that the growth trend gradually increased in recent years. The years 1999 to 2002 contributed equal number (more than 3%) publications

each year in the subject of aquaculture research output 2006 publications (1.19% increased) suddenly increased more than 2005, 2004, 2003, 2002, 2001, 2000 and 1999 production; followed by the 2010, 2011 and 2013 having difference between the previous year's publication in the area of aquaculture research output.

Half of the records were produced after 2008, i.e., after ten years; two third records were calculated in 2011, i.e., just two years gap. So this trend shows that the recent years (after 2009) publication is more than the starting years publication (1999 to 2008). Particularly, last decade (2011

to 2013) has good number of publications in the field of aquaculture. It could be derived from the above analysis that the years 2011, 2012 and 2013 have highest number of publications in the area of aquaculture.

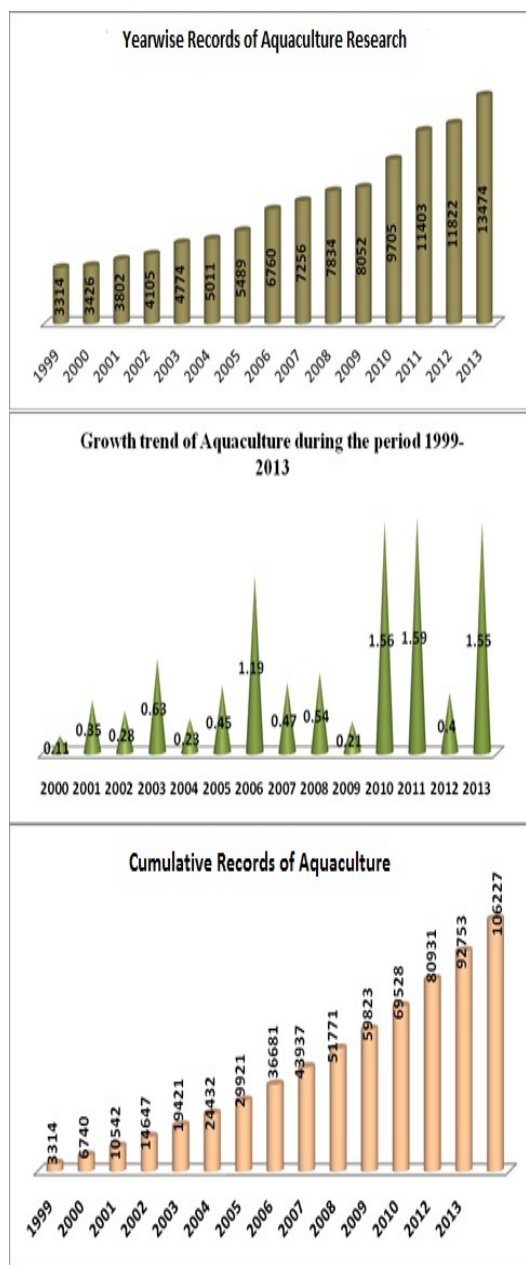


Fig. 1 Year wise distribution of Aquaculture Research Output

An analysis of preference channels of communication by the productive scientists for publication output in aquaculture is an essential aspect of bibliometric and scientometric analysis. Scientists have communicated their publications through a variety of communication channels. The eight (8) document types have brought out this aquaculture research output at the global level such as articles; conference proceeding papers; Letters; Reviews; Notes, Short Surveys; Errata and Editorials.

The below table shows that the researcher has divided the study period into the three year groups: 1999 to 2003; 2004 to 2008 and 2009 to 2013. The table shows that the articles from the journal source capture the first position among the other sources; the articles covered 95118 (89.54%); next to that the conference proceeding papers are 5532 (5.21%); the conference proceeding papers as a source of aquaculture research publication output follows second order position of publication output taken for this analysis. Followed by the

format of Letter sources have 3945 (3.71%) of publications; the review sources have 908 (0.85%) publications; the for Note sources have 227 (0.21%) publications; the Short Survey sources have 214 (0.20%) publications; the Erratum

sources have produced 166 (0.16%) publications and the Editorial sources have produced 116 (0.11%) publications in the subject of aquaculture research output.

TABLE II ANALYSIS OF SOURCE WISE OF AQUACULTURE RESEARCH OUTPUT

| S.No | Source Types | 1999 - 2003 | 2004 - 2008 | 2009 - 2013 | Total |
|------|-------------------|------------------|------------------|------------------|------------------|
| 1 | Article | 17264 (18.15) | 28324 (29.78) | 49531 (52.07) | 95118 (89.54) |
| 2 | Conference papers | 1283 23.19) | 2078 (37.56) | 2171 (39.24) | 5532 (5.21) |
| 3 | Letter | 15 (0.38) | 1674 (42.43) | 2256 (57.19) | 3945 (3.71) |
| 4 | Review | 732 (80.62) | 71 (7.82) | 105 (11.56) | 908 (0.85) |
| 5 | Note | 34 (14.98) | 31 (13.66) | 162 (71.37) | 227 (0.21) |
| 6 | Short Survey | 51 (23.83) | 76 (35.51) | 87 (40.65) | 214 (0.20) |
| 7 | Erratum | 16 (9.64) | 59 (35.54) | 91 (54.82) | 166 (0.16) |
| 8 | Editorial | 26 (22.41) | 37 (31.9) | 53 (45.69) | 116 (0.11) |
| | Total | 19421 (18.28) | 32350 (30.45) | 54456 (51.26) | 106227 |

18.28 percent of publications were in the year group of 1999 to 2003; 30.45 percent of publications were in the year group of 2004 to 2008 and 51.26 percent of publications were in the year group of 2009 to 2013. It could be noted that the third year group of 2009 to 2013 has produced more than half of the sample records in the subject of aquaculture research output.

The article sources have 18.15 percent of publications in 1999 to 2003 year group; 29.78 percent of publications were in the year group of 2004 to 2008 and 52.07 percent of publications were in the year group of 2009 to 2013. The source of conference proceeding papers has 23.19 percent of publications in the year group of 1999 to 2003; 37.56 percent of publications were in the year group of 2004 to 2008 and 39.24 percent of publications in the year group of 2009 to 2013. The form of Letter source publications is highest in the year group of 2009 to 2013; followed by the form of Review source publications in the year group of 1999 to 2003; the form of Note sources produced highest publication in the year group of 2009 to 2013; the form of Short survey sources, the form of Erratum and Editorial sources produced highest publications in the year group of 2009 to 2013 respectively.

This analysis reveals the source wise publications compared to the selected year groups. Generally the journal articles have dominant place among the eight types of sources. Next to that proceeding papers are in second place of their publication status. Remaining sources have very low publications in the area of aquaculture.

It could be presumed from the above discussion that journal articles predominate over other sources of publications in

aquaculture productivity during the sample period. More than fifty percent of publications were produced by the year group of 2009 to 2013. It occupies the pivotal place in journals as a medium of scientific communication more than any other form of publication. Majority of the aquaculture scientists have published their research papers in journal articles. Hence, this hypothesis (the journal source of publication of Aquaculture research output occupies the predominant place in comparison with other source of publications) which is noted in analysis has been substantially proved.

Language wise analysis is vital part of any kind of research output in any discipline which is a key factor of communication of research information. The researchers/ Scientists throughout the globe do not know all languages. Generally English language is the medium of research communication as it is widely recognized all over the world. However, a few research papers have been published in other languages. Keeping this point in mind, an attempt is made here to analyze the language medium of published output in aquaculture research output. This type of analysis enables one to identify the most preferred language of publishing in the area of aquaculture research output.

The table presents data of thirty one types (English, French, Japanese, Spanish, Portuguese, Chinese, Turkish, German, Polish, Korean, Russian, Italian, Croatian, Czech, Persian, Thai, Arabic, Lithuanian, Hungarian, Malay, Dutch, Slovenian, Norwegian, Slovak, Estonian, Serbian, Indonesian, Romanian, Finnish, Bosnian and Danish) of languages which brought out the Aquaculture research output during the sample periods.

TABLE III DISTRIBUTION OF LANGUAGES ON AQUACULTURE RESEARCH PUBLICATIONS

| S.No. | Language | 1999-2003 | 2004-2008 | 2009-2013 | Total |
|-------|------------|-----------|-----------|-----------|----------------|
| 1 | English | 18937 | 31724 | 53714 | 104375 (98.26) |
| 2 | French | 88 | 94 | 107 | 289 (0.27) |
| 3 | Japanese | 87 | 91 | 95 | 273 (0.26) |
| 4 | Spanish | 93 | 82 | 93 | 268 (0.25) |
| 5 | Portuguese | 61 | 82 | 91 | 234 (0.22) |
| 6 | Chinese | 41 | 83 | 93 | 217 (0.20) |
| 7 | Turkish | 16 | 54 | 67 | 137 (0.13) |
| 8 | German | 28 | 33 | 38 | 99 (0.09) |
| 9 | Polish | 21 | 27 | 32 | 80 (0.08) |
| 10 | Korean | 11 | 17 | 26 | 54 (0.05) |
| 11 | Russian | 14 | 16 | 9 | 39 (0.04) |
| 12 | Italian | 8 | 13 | 18 | 39 (0.04) |
| 13 | Croatian | 7 | 10 | 13 | 30 (0.03) |
| 14 | Czech | 2 | 4 | 9 | 15 (0.014) |
| 15 | Persian | - | 2 | 8 | 10 (0.009) |
| 16 | Thai | - | 8 | 1 | 9 (0.008) |
| 17 | Arabic | 1 | 1 | 6 | 8 (0.008) |
| 18 | Lithuanian | - | - | 7 | 7 (0.007) |
| 19 | Hungarian | 2 | 2 | 2 | 6 (0.006) |
| 20 | Malay | - | 2 | 4 | 6 (0.006) |
| 21 | Dutch | 2 | 1 | 2 | 5 (0.005) |
| 22 | Slovenian | - | 1 | 4 | 5 (0.005) |
| 23 | Norwegian | - | 1 | 4 | 5 (0.005) |
| 24 | Slovak | 2 | - | 2 | 4 (0.004) |
| 25 | Estonian | - | - | 4 | 4 (0.004) |
| 26 | Serbian | - | 1 | 2 | 3 (0.003) |
| 27 | Indonesian | - | - | 2 | 2 (0.002) |
| 28 | Romanian | - | - | 1 | 1 (0.001) |
| 29 | Finnish | - | 1 | - | 1 (0.001) |
| 30 | Bosnian | - | - | 1 | 1 (0.001) |
| 31 | Danish | - | - | 1 | 1 (0.001) |
| | Total | 19421 | 32350 | 54456 | 106227 |

In the percentage analysis, English language (98.26%) dominates in the first place among those thirty one languages. The other languages French, Japanese, Spanish, Portuguese and Chinese language publications have above 200 in aquaculture research output. Remaining language publications are very low. It could be noted that the English language is dominant for all types of publications, and this analysis shows that in the aquaculture research output also 99 percent of publications are in the English language.

The table shows that the continents contribution of the research output on Aquaculture during 1999 to 2013 (fifteen years) from 176 different countries. Some countries are repeatedly shown in two continents, because the map itself shows that those countries belong to both continents. At the

comprehensive level, the duration periods are having the highest research productivity is Europe. The status of research shows the variation during these year groups.

European continents have 35579 (33.49%) research outputs produced by 54 (30.68%) different countries; followed by Asian continent which produced 31356 (29.52%) publications from 42 (23.86%) different countries; North America continent produced 24841 (23.38%) publications from 26 (14.77%) different countries; Australia continent produced 5958 (5.61%) publications from 11 (6.25%) different countries; South America continent produced 5899 (5.55%) publications from 11 (6.25%) different countries; and Africa continent produced 2594 (2.44%) publications from 32 (18.18%) different countries in aquaculture research output.

TABLE IV OVERALL CONTINENT WISE RESEARCH OUTPUT OF AQUACULTURE DURING 1999 TO 2013

| Continents | No. of countries | Percent | Research output | Percent |
|----------------|------------------|---------|-----------------|---------|
| Europe | 54 | 30.68 | 35579 | 33.49 |
| Asia | 42 | 23.86 | 31356 | 29.52 |
| North American | 26 | 14.77 | 24841 | 23.38 |
| Australia | 11 | 6.25 | 5958 | 5.61 |
| South America | 11 | 6.25 | 5899 | 5.55 |
| Africa | 32 | 18.18 | 2594 | 2.44 |
| Total | 176 | 100 | 106227 | 100 |

The researcher concludes from the analysis based on the three year groups output of the overall percentage that the three year groups are 1999 to 2001; 2002 to 2004; 2005 to 2007; 2008 to 2010 and 2011 to 2013. Among those three

year groups, 2011 to 2013 produced more number of publications in the selected area of aquaculture. It shows reverse wise highest publications.

TABLE V DISTRIBUTION OF YEAR WISE VS. CONTINENTS WISE RESEARCH OUTPUT OF AQUACULTURE

| Rank | Continents | Records | 1999-01 | 2002-04 | 2005-07 | 2008-10 | 2011-13 |
|------|---------------|---------|---------|---------|---------|---------|---------|
| 1 | Europe | 35579 | 4121 | 4914 | 6579 | 8408 | 11557 |
| 2 | Asia | 31356 | 2041 | 3339 | 5277 | 7988 | 12711 |
| 3 | North America | 24841 | 3106 | 3814 | 4938 | 5730 | 7253 |
| 4 | South America | 5899 | 336 | 549 | 970 | 1521 | 2523 |
| 5 | Australia | 5958 | 718 | 998 | 1257 | 1299 | 1686 |
| 6 | Africa | 2594 | 218 | 273 | 475 | 667 | 961 |
| | Total | 106227 | 10542 | 13890 | 19505 | 25591 | 36699 |

It shows that in the recent years (last ten years) the aquaculture publications have increased. The first year group 1999 to 2001 has 10542 publications; it measured less number of publications among other year groups. The European continent establishes the highest publication

among other continents. Hence, the fourth (There is a significant variation in the growth and deliberation of research output on Aquaculture research among the continents and countries. Hence, this hypothesis is proved.

TABLE VI SPECIALIZATION INDEX OF SELECTED CONTINENTS RESEARCH OUTPUT ON AQUACULTURE

| S.No | Continent | SI |
|------|---------------|------|
| 1 | Europe | 1.03 |
| 2 | Asia | 0.92 |
| 3 | North America | 1.04 |
| 4 | South America | 0.90 |
| 5 | Australia | 1.08 |
| 6 | Africa | 0.96 |
| | Total | 5.93 |

The above table indicates the continents' specialized index value and shows how they are related to their publication at the world level. All continents don't have specialized relation to the world output. The calculated specialized index values are European continent (1.03); Asian continent

(0.92); North American continent (1.04); African continents (0.96); Australian continent has (1.08) and South America (0.90). It could be noted that Europe, North American and Australia have highest specialized relation to the world research output because their SI value is greater than 1.

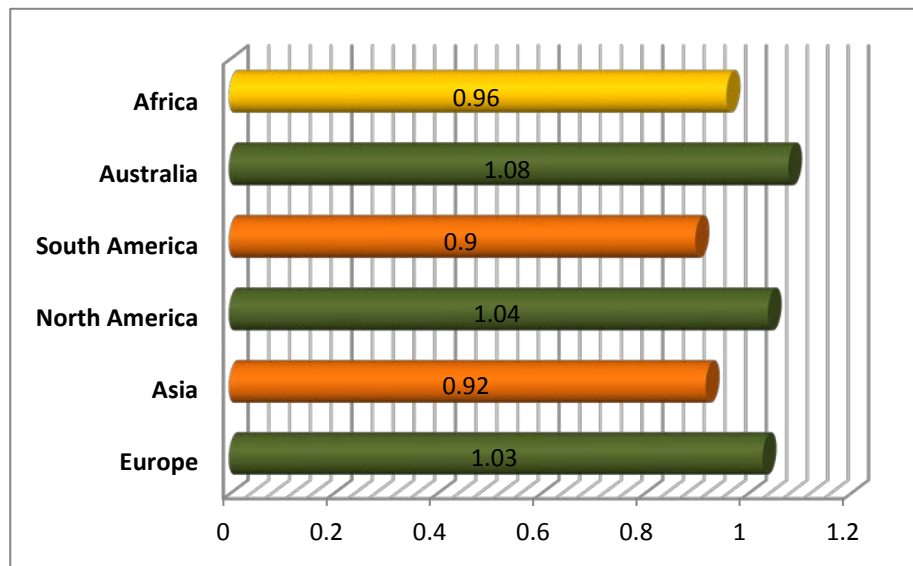


Fig. 2 Specialization Index of Selected Continents

VI.CONCLUSION

The researcher has derived the result from this aquaculture research analysis, that the last three years of 2011, 2012 and 2013 has highest publications; 1395 countries were contributed 106227 articles from seven different continents. The journal articles predominate over other sources of publications in aquaculture productivity during the sample period. In the percentage analysis, English language (98.26%) dominates in the first place among those thirty one languages. The other languages French, Japanese, Spanish, Portuguese and Chinese language publications have above 200 in aquaculture research output. European continent leads the first rank position in publication level. Overall USA, UK, Canada, Spain, Japan, Australia, France and Norway produced highest number of articles in aquaculture research. All continents productivity has highest in the year group 2011 to 2013. Asian and Australian continents have specialized relation with world

output on aquaculture research during the sample time span 1999 to 2013.

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