LS39
# Scientific Footprint of South Asian Fisheries and Aquaculture Research: A Scientometric Study between 2000 and 2017

Tharindu Bandara[1], Lishani Nisansala Wijewardene[2]

## ABSTRACT

The multifaceted role of South Asian fisheries and aquaculture includes improving nutritional status, livelihood development and poverty alleviation of the associated nations. Application of scientific knowledge to utilize the full potential of South Asian fisheries and aquaculture has been discussed in many scientific forums, conferences and other published literature. Systematic analysis of this published literature may provide insight into the future research directions and identify the potential impact of South Asian fisheries and aquaculture research. In this context, a scientometric analysis in South Asian fisheries and aquaculture research was conducted for the period of 2000-2017 using Web of Science database™. Quantitative analysis of growth trends in publications, prolific authors, and journals, was carried out by using 'R' programming platform and package *'bibliometrix'*. The 'VOSviewer' software tool was employed to identify the key-word co-occurrence of published research articles in South Asian fisheries and aquaculture research. A total of 1755 articles related to South Asian fisheries and aquaculture were retrieved. Findings of the present study indicated that the, growth rate of articles in indexed publications is declining. India was the most influential country with the highest number of publications (1159). Indian Journal of Fisheries was the top journal with the highest article count (160). Keyword co-occurrence analysis has identified 10 distinct clusters related to the various themes of fisheries and aquaculture research. Fisheries management was the dominant research area with the highest number of associated keywords (52). Present study also suggested that strong country-level collaboration with developed countries, increase funding for research infrastructure and effective participation in international research arena are mandatory for more productive fisheries and aquaculture research output in South Asia.

*Keywords:* Fisheries, Aquaculture, Scientometrics, South Asia, bibliometrix

## INTRODUCTION

The South Asian region/Indian subcontinent consists of eight neighbouring countries including India, Bangladesh, Sri Lanka, the Maldives, Afghanistan, Bhutan, Pakistan, and Nepal. In terms of global poverty statistics, South Asia is home to nearly 40% of the world's poorest people with a considerable level of malnourishment (UNDP, 2015). The potential of using fish as a source of highly nutritious product and its ability to eliminating the malnourishment of these developing countries is well documented (Beveridge et al., 2013; Müller and Krawinkel, 2005). Other than addressing the issue of malnutrition, fisheries and aquaculture significantly contributed to the national economy of South Asian insular nations such as Sri Lanka and the Maldives (NARA, 2015;

[1] *Department of Aquaculture and Aquatic Resources Management, University College of Anuradhapura, University of Vocational Technology, Sri Lanka.* Corresponding Author: tharinduacademia@hotmail.com
[2] *Department of Limnology and Water Technology, University of Ruhuna, Matara, Sri Lanka*

NBS, 2015). On the other hand, fisheries and aquaculture contribute to livelihood development and poverty alleviation in many South Asian nations.

The growing importance of fisheries and aquaculture practices in South Asia has driven increase Research and Development (R &D) activities in the region. These R & D activities have led to a large number of conferences, meetings, and other published literature (Jayashree and Arunachalam, 2000). Quantitative analysis of these publications may act as a valuable tool for tracking the emerging trends, limitations, and strengths of fisheries and aquaculture studies in the region. Therefore, the present study focused on quantitative analysis of published scholarly work related to the South Asian fisheries and aquaculture research during 2000-2017 on the Web of Science™ (WOS) database. It aims to understand   (1). Growth trends of publications, (2). Dominating countries, journals, authors (3). Thematic research areas pertaining to fisheries and aquaculture research in South Asia.

## MATERIAL AND METHODS

Extraction of the data for the present study was carried out by using the ISI Web of Science™ database (WOS) on 11/2/2018. Journal articles related to the South Asian fisheries and aquaculture were queried by using the following search query on WOS database.

*TS= ("Aquaculture" OR "Fisheries") AND AD= ("Afghanistan" OR "Bangladesh" OR "Bhutan" OR "India" OR "Maldives" OR "Nepal" OR "Pakistan" OR "Sri Lanka")*

*Here TS= Topic and AD= Address*

*Databases= SCI-EXPANDED, SSCI, A&HCI (Science Citation Index Expanded, Social Science Citation Index, Arts and Humanities Citation Index)*

The Above search query was further refined by selecting journal articles written only in English language and published during 2000-2017. Metadata related to the selected journal articles were obtained in bibliographic information /BibTex (.BIB) file format and analyzed on R statistical program version 3.3.1 (R Development Core Team, 2016) by using *bibliometrix* package (Aria and Cuccurullo, 2016). The package *bibliometrix* provides a set of quantitative tools for analyzing the scientometric data on R statistical programming platform.The increment of number of articles per unit amount of time/ Relative Growth Rate (RGR) was calculated by the equation as described by Santhakumar and Kaliyaperumal (2014).

$$RGR = (\ln W_2 - \ln W_1)/(T_2 - T_1)$$

Where,

RGR - Mean relative growth of publications over a specific period of interval

$\ln W_1$ – Natural logarithm of initial number of articles

$\ln W_2$ - Natural logarithm of final number of articles

$T_2\text{-}T_1$ – Time difference between initial and final time (with regard to immediate previous year)

The time required to double the article count, compared with the previous year count/ doubling time (DT) was calculated by the equation as described by Mahapatra (1994),

$$DT = 0.693/RGR$$

Where,

DT=Doubling Time

RGR= Relative Growth Rate of the publications for the same year

Prolific authors, journals and countries were also analyzed by using the available tools in package *bibliometrix*. The VOS viewer version 1.6.7 (van Eck and Waltman, 2010) software tool was employed to visualize the keyword co-occurrence and co-authorship patterns of research articles.

## RESULTS AND DISCUSSION

The search query on WOS database returned 1755 articles and relevant metadata related to the South Asian fisheries and aquaculture. A maximum number of articles (263) were published in 2017 and a minimum number of articles (14) were published in 2000 (Table 1). The highest RGR (1) was recorded in 2001 and minimum RGR (0.12) was recorded in 2015. However, the mean RGR of publications has shown a declining trend. Comparatively, the DT for publications has shown an increasing trend. Although South Asian fisheries and aquaculture sector provides a great number of benefits to the regional citizens, declining RGR and increasing DT may imply that lacuna of quality research. This can be caused by inadequate financial and research infrastructure facilities in most of the South Asian fisheries and aquaculture research institutes. Moreover, increased article processing time in most of the open access journals (indexed) may also affect the annual growth rate of publications (Björk, 2013). Although there is no current study related to the publication delays in fisheries and aquaculture articles in major South Asian journals, several other studies have shown higher article processing time/ delayed peer review process in most of the regional open access journals. Within these journals, the average delay for the article may range from 2.86-22.4 months from the date of first submission (Garg, 2016; Shah et al., 2016). The Selected 1755 articles scattered over the 470 Journals while Indian Journal of Fisheries was the top journal with the highest number of article count (160). Country-level publication statistics have shown that India has dominated with the highest number of publications (66.04%) followed by Bangladesh (5.70%) and Pakistan (3.36%). Based on the *h*-index, the top three authors were Wahab, M. (21), Verdegem, M. (18) and Karunasagar, I., Hossain, M. and Islam, M. (each having h-index of 13).

Table 1: Relative Growth Rate (RGR) and Doubling Time (DT) of articles related to South Asian fisheries and aquaculture (2000-2017)

| Year | Publication count | Cumulative total of publications | ln W1 | ln W2 | RGR | DT |
|------|------|------|------|------|------|------|
| 2000 | 14 | 14 | - | 2.64 | - | - |
| 2001 | 24 | 38 | 2.64 | 3.64 | 1.00 | 0.69 |
| 2002 | 30 | 68 | 3.64 | 4.22 | 0.58 | 1.19 |
| 2003 | 32 | 100 | 4.22 | 4.61 | 0.39 | 1.80 |
| 2004 | 48 | 148 | 4.61 | 5.00 | 0.39 | 1.77 |
| 2005 | 41 | 189 | 5.00 | 5.24 | 0.24 | 2.83 |
| 2006 | 58 | 247 | 5.24 | 5.51 | 0.27 | 2.59 |
| 2007 | 68 | 315 | 5.51 | 5.75 | 0.24 | 2.85 |
| 2008 | 69 | 384 | 5.75 | 5.95 | 0.20 | 3.50 |
| 2009 | 76 | 460 | 5.95 | 6.13 | 0.18 | 3.84 |
| 2010 | 112 | 572 | 6.13 | 6.35 | 0.22 | 3.18 |
| 2011 | 116 | 688 | 6.35 | 6.53 | 0.18 | 3.75 |
| 2012 | 118 | 806 | 6.53 | 6.69 | 0.16 | 4.38 |
| 2013 | 172 | 978 | 6.69 | 6.89 | 0.19 | 3.58 |
| 2014 | 167 | 1145 | 6.89 | 7.04 | 0.16 | 4.40 |
| 2015 | 146 | 1291 | 7.04 | 7.16 | 0.12 | 5.77 |
| 2016 | 201 | 1492 | 7.16 | 7.31 | 0.14 | 4.79 |
| 2017 | 263 | 1755 | 7.31 | 7.47 | 0.16 | 4.27 |

Keyword co-occurrence of each manuscript can effectively reflect the hotspots in the discipline field thus providing auxiliary support for the scientific research (Li et.al, 2016). Out of 4966 author keywords in all articles, 219 keywords with a minimum threshold of co-occurrence (5) have been represented in Figure 1. Keyword co-occurrence algorithm of VOSviewer has clustered the 219 author keywords into 10 major clusters (nodes with similar colour belong to the same cluster). In each cluster, size of the node and the word is proportional to the weight/frequency of the node (Chen et.al, 2016; Liao et.al, 2018). The bigger the word and node, larger the weight/frequency. Each cluster has a different number of keywords. Cluster with the largest number of keywords is most centralized research area (Hu and Zhang, 2015). This indicates that the cluster with red colour was the dominant research area having 52 keywords. Term analysis of this cluster indicated that fisheries management was dominant research area in South Asian fisheries and aquaculture studies (Table 1). Other than fisheries management, studies on eutrophication (cluster 2) and fish and shrimp health management (cluster 3, 4 and 7) were also popular research areas. In contrast to that, studies on extensive aquaculture practices (cluster 10) and microalgae (cluster 9) were not popular among the identified themes. Shifting extensive aquaculture practices towards the intensive production and higher capital cost regarding large-scale microalgae culture may hinder the related research in respective areas.

Table 1: Keyword clusters and possible research areas as depicted by keywords

| Cluster number | Number of keywords | Selected Keywords (Up to 5) | Possible research area |
|---|---|---|---|
| 1 | 52 | Bangladesh, fisheries management, GIS, aquaculture. fisheries | Fisheries management |
| 2 | 31 | Phosphorus, Nitrogen, phytoplankton, nutrient, water quality | Eutrophication studies |
| 3 | 28 | *Aeromonas hydorphila*, probiotics, immunostimulant, disease resistance, lysozyme | Fish diseases/fish immunology |
| 4 | 26 | Artemia, antimicrobial activity, *Bacilius licheniformis, Macrobrachium rosenbergii,* microsatellite | Probiotic studies on shrimp |
| 5 | 19 | polyculture, food web, productivity, Chinese carps, silver carp | Aquaculture production |
| 6 | 17 | Salinity, gonado-somatic index, reproduction, ovary, temperature, mortality | Fish reproduction |
| 7 | 15 | *Peaneus monodon*, shrimp aquaculture, WSSV, *Penaeus vannamei* | Shrimp aquaculture and diseases |
| 8 | 12 | bacteriophage, biofilm, phage therapy, quorum sensing, vibriosis | Bacteria/bacterial infections |
| 9 | 12 | bioremediation, microalgae, *Pseudomonas,* phylogeny, response surface method | Microalgae aquaculture |
| 10 | 5 | freshwater prawn, C/N ratio, heterotrophic-bacteria, periphyton, tilapia | Extensive aquaculture |
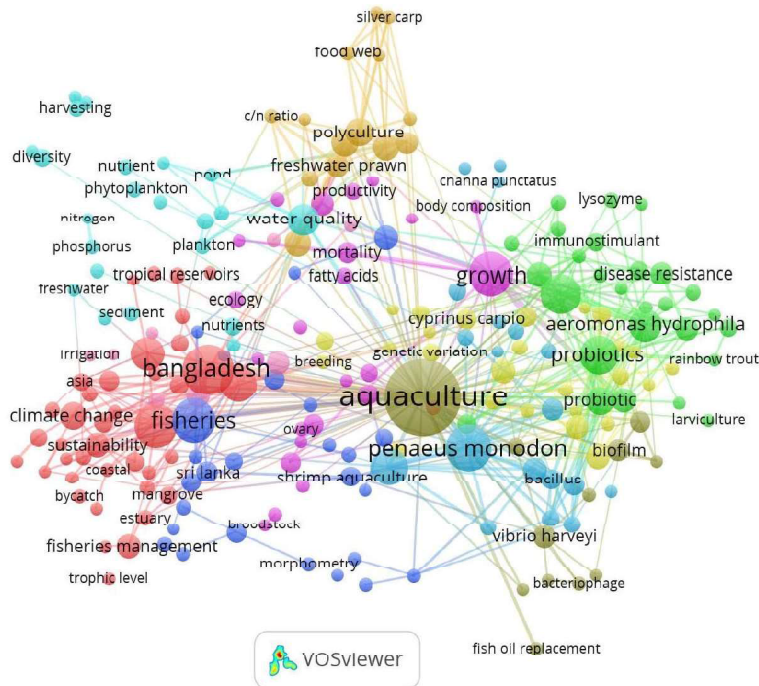
Figure 1: Keyword co-occurrence network related to the South Asian fisheries and aquaculture articles (2000-2017) (n clusters=10, n links=1268)

## CONCLUSION

The present study analyzed the published scholarly literature related to the South Asian fisheries and aquaculture research during the 2000-2017 on WOS database. Quantitative analyses of scientometric data showed that India has played a dominant role in fisheries and aquaculture research in South Asia. The present study retrieved only 1755 research articles published during 2000-2017.   However, total research output in fisheries and aquaculture may exceed the current amount as most of the other articles could be published in non-indexed journals. Therefore, analyzing the other databases (e.g. Scopus, AGRICOLA and DOAJ, etc.) may provide extended details for the current study. Furthermore, strong institutional collaborations, state-of-art research technologies, increased funding for scientific infrastructure may act as an impetus for the future development of fisheries and aquaculture research in South Asia.

## REFERENCES

Aria, M., & Cuccurullo, C. (2016). A brief introduction to bibliometrix.   Retrieved from https://cran.r-project.org/web/packages/bibliometrix/vignettes/bibliometrix-vignette.html

Beveridge, M. C. M., Thilsted, S. H., Phillips, M. J., Metian, M., Troell, M., & Hall, S. J. (2013). Meeting the food and nutrition needs of the poor: the role of fish and the opportunities and challenges emerging from the rise of aquaculture (a). *Journal of Fish Biology*, 83(4), 1067-1084. doi:10.1111/jfb.12187

Björk, B.C. & Solomon, D.C. (2013). The publishing delay in scholarly peer-reviewed journals. *Journal of Informetrics*, 7, 914–23

Chen, X., Chen, J., Wu, D., Xie, Y. & Li, J. (2016). Mapping the Research Trends by Co-word

Analysis Based on Keywords from Funded Project. *Procedia Computer Science.* 91, 547-555.

Garg, K.C. (2016). Publication delay of manuscripts in periodicals published by CSIR-NISCAIR. *Current Science,* 111(12), 1924-1928

Hu, J., & Zhang, Y. (2015). Research patterns and trends of Recommendation System in China using co-word analysis. *Information Processing & Management,* 51(4), 329-339.

Jayashree, B., & Arunachalam, S. (2000). Mapping fish research in India. *Current Science,* 79(5), 613-620.

Li, H., An, H., Wang, Y., Huang, J. & Gao, X. (2016). Evolutionary features of academic articles co-keyword network and keywords co-occurrence network: Based on two-mode affiliation network. *Physica A: Statistical Mechanics and its Applications,* 450, 657-669.

Liao, H., Tang, M., Luo, L., Li, C., Chiclana, F. & Zeng, X.J. (2018). A Bibliometric Analysis and Visualization of Medical Big Data Research. *Sustainability,* 10 (1), 166.

Mahapatra, G., (1994). Correlation between growth of publications and citations: A study based on growth curves. *Annals of Library and Documentation,* 41(1), 8-12.

Müller, O., & Krawinkel, M. (2005). Malnutrition and health in developing countries. *Canadian Medical Association Journal,* 173(3), 279-286.

NARA. (2015). Fisheries Industry Outlook (2015). Retrieved from http://www.nara.ac.lk/wp-content/uploads/2017/09/2015-Fisheries-Outlook-1.pdf

NBS. (2015). Gross Domestic Product-GDP revision (2016). Retrieved from http://statisticsmaldives.gov.mv/gdp-revision-october-2016/

R Development Core Team. (2016). R: A language and environment for statistical computing Vienna, Austria: R foundation for statistical computing. Retrieved from https://cran.r-project.org/

Santhakumar, R. & Kaliyaperumal, K. (2014). Mapping of Mobile Technology Publications: A Scientometric Approach. *DESIDOC Journal of Library & Information Technology,* 34(4), 298-303.

Shah, A., Sherighar, S.G. & Bhat, A. (2016). Publication speed and advanced online publication: Are biomedical Indian journals slow? *Perspectives in Clinical Research,* 7(1), 40-44

UNDP. (2009). Human Development Data (2000-2015). Retrieved from http://hdr.undp.org/en/data

van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics,* 84(2), 523-538. doi:10.1007/s11192-009-0146-3