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

Tharindu Bandara<sup>1</sup>, Lishani Nisansala Wijewardene<sup>2</sup>

### 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<sup>™</sup>. 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; 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

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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<sup>™</sup> (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<sup>™</sup> 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).

 $RGR = (lnW_2 - lnW_1)/(T_2 - T_1)$ Where,

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

InW<sub>1</sub> – Natural logarithm of initial number of articles

InW2 - Natural logarithm of final number of articles

 $T_2-T_1$  – 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).

Year	Publication	Cumulative total	ln W1	ln W2	RGR	DT
	count	of publications				
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

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

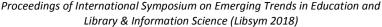
Keyword co-occurrence of each manuscript can effectively reflect the hotspots in the discipline field thus providing auxiliary support for the scientific research (Li et.al, 2016). Out of 4966 author keywords in all articles, 219 keywords with a minimum threshold of co-occurrence (5) have been represented 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

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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.

Cluster	Number of	Selected Keywords (Up to 5)	Possible research area	
number	keywords			
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, <i>Bacilius licheniformis,</i> <i>Macrobrachium rosenbergii</i> , 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, <i>Pseudomonas</i> , phylogeny, response surface method	Microalgae aquaculture	
10	5	freshwater prawn, C/N ratio, heterotrophic-bacteria, periphyton, tilapia	Extensive aquaculture	

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



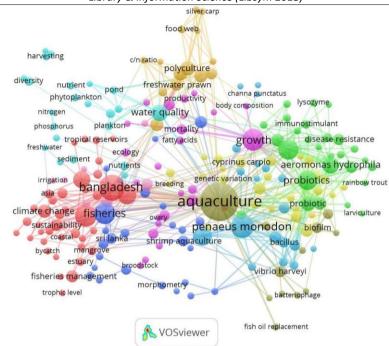


Figure 1: Keyword co-occurrence network related to the South Asian fisheries and aquaculture articles (2000-2017) (n clusters=10, n links=1268)

#### 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.

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