

Scientometric Profile of Fisheries Research in SAARC Countries

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ABSTRACT

This paper provides a quantitative assessment of research output in SAARC countries in the domain of Fishery Science. The primary data for this study have been sourced from Scopus database for the period 1994 to 2021. The findings of the study highlight that a total of 1190 publications of different forms are available with 8820 citations with an average citation per year per document of 1.732 and annual growth of 4 articles per year in the 28 years window. The growth rate of publication is found to be highly consistent. A total of 4784 authors contributed their research items in the period of study and the number of multi-authored or collaborated works are found to be maximum (4750) and only 34 publications are found to be single-authored with a degree of collaboration of 0.99. India is the leading nation among the other SAARC nations with 75.97% of the publication (904 publications) and 8164 citations to those publications. Khan, MA is found to be the author with the highest number of publications (35) but Harikrishnan, R is the most influential author (highest g-index = 27) with 1100 total citations in 27 publications. *Aquaculture Research* is the journal with maximum publications (66). There exists a significant correlation between h-index and g-index in authors and journals.

Keywords: Fishery science; Quantitative study; Research collaboration; Co-authorship network; Scopus; h-index; Citation impact; SAARC countries

1. INTRODUCTION

Fish are animals in aquatic habitats with skulls, gills, and limbs with low muscular strength. Fish were the first vertebrate animals to evolve on earth. The largest diversity of more than 30,000 species is found in Coral reefs in the tropic region of the world. Fishery Science is an academic discipline concerning with managerial aspects of fisheries. It is a multi-disciplinary science including the prospects of disciplines like economics of fishes, marine biology, decision analysis, conservation, ecology, management, fresh-water biology, oceanography, meteorology, population dynamics and many other approaches to depict an integrated picture of fisheries. Fish as food is healthy as these are a good source of protein, have low fats than meat, low level of cholesterol, and free from unnecessary fatty acids. Moreover, ornamental fishes are good decoration materials as they constitute an aquarium which is often seen in public places like malls, airports and even guests' room in houses.

The scientometric study deals with the quantification of scholarly communication helping the measurement of published knowledge by analyzing literature, productivity, the interrelation between different branches of knowledge, degree of collaboration, authorship pattern, affiliation, funding agencies promoting research. Science mapping has been a prominent research area in the field of Library and Information Science and has contributed immensely to academic upliftment and

generation of new information in any discipline of the subject. In this effort, scientometric techniques are used to mark the status of research on fisheries science in SAARC countries. Pisciculture involves a lot of capital investment and gives a huge turnover if everything goes fine. Lots of sponsoring agencies fund research in fishery science. For instance, in India DBT, DST, and UGC fund lots of projects which are going on in different universities and research institutes. The findings of the study will be a source of information for the funding agencies and sponsors as this study gives an overview of the co-authorship network of authors which gives insight on prolific authors and their institutions of affiliation. The findings of this study are also valuable for library professionals working in various academic and research institutes to provide information to the academic community on the recent trends in research of fishery science in terms of journals, authors, collaboration with peers from other institutions. The scholar community at large from backgrounds like zoology, agricultural science working on fish biology can find information on production and impact of authors and sources in fishery science and position of research by SAARC countries in this discipline. The outcome of this evaluation can constitute benchmarks for invigilating the research in the field in the author level as well as journal-level and impact of research as it involves studying performance indicators like h-index and their correlations with other indicators g-index.

2. LITERATURE REVIEW

Several studies have been conducted which analysed the

performance of researchers working in Fisheries research. Some studies were aimed at making a bibliometric study of the literature available and some are on the researcher's profile. Some of such studies are reviewed here. Agarwal and Rana (1994)¹ evaluated research patterns in Indian wildlife and fisheries on the basis of authorship and collaboration aspects with data collected from "Wildlife Review and Fish Review" published between 1980 to 1989. The findings of the study are very interesting which reveals those single-authored papers share have decreased from 63.68 per cent in 1980 to 52.74 per cent in 1989 which indicates an increase in research collaboration. Likewise, Jayashree and Arunachalam (2000)² used six databases namely CAB Abstracts, Science Citation Index (SCI), BIOSIS Biological Abstracts, BBCI (Biophysics and Biochemistry Citation Index), Biotechnology Citation Index (BTCI), Aquatic Science and Fisheries Abstracts (ASFA) to map fish and aquaculture research in India over the period 1994 to 1999. Similarly, Jaric *et al.*, (2012)³ evaluated the trends in fisheries science from 2000 to 2009 using bibliometric indicators with data sourced from the ISI Web of Knowledge online database. The study attempts to identify recent patterns and trends in the methods, subjects, and authorships in fisheries science. A different study was conducted by Aksnes and Browman (2014)⁴. They prepared a scientometric profile of the Norwegian fishery scientist Johan Hjort. The study uses bibliometric indicators to evaluate the research performance of the scientist based on citations. Using the Web of Science database as the source of data the authors prepare a list of journals that cite Johan's articles mostly. A year later, Aksnes and Browman (2016)⁵ used bibliometric indicators to give insight to research activities in fisheries science from 2010 to 2013. Vinita *et al.*, (2018)⁶ analysed fishery research in India from 1992 to 2016 The study aimed to estimate Indian productivity, chronological growth, productive author, collaborative nations, productive institution, preferred journal, document type, language, and highly cited journal article and references. Both two studies are sourced on primary literature in fisheries research indexed in Web of Science as a source of data.

There are some literatures available on bibliometric assessment of fisheries Science research at the global and at country level. Almost all papers use scientometric indicators to evaluate research output in the subject. On extensive review of this literature, it is observed that the research in these articles is not carried out with any hypothetical assertion, so the research is not adopting any statistical tool to interpret results which makes the results less efficient. The literature reviewed only finds top institute, preferred journal, top author, collaborating country, etc. based on citations, number of publications, etc. but does not try to find the interrelationships between the variables like evaluation of correlation in author level and journal level with different performance metrics as dependent and exploratory variables. The studies also do not evaluate Relative Citation Impact (RCI) and Absolute Citation Impact (ACI) which provides the basis to compare the research performance of countries to global output precisely and accurately making the results efficiently. Moreover, the studies reviewed are concerned with data on fisheries at the global level

or at the Indian level but not for SAARC nations in particular. The studies are based on data sourced from different databases including Web of Science but no study includes data sourced from the Scopus database. In addition, some of the studies are conducted long back during 1994 and the latest being 2018 is also too long. 1994 to 2021 includes several decades which is sufficient to analyse the research trends in a specific discipline. Hence, this study finds significance for all the mentioned discrepancies in the previous studies and attempts to fulfill the research gap.

3. SCOPE OF THE STUDY

The study is limited to Scientometric assessment of Fishery Science and Fish Biology Research by SAARC nations as per data available in the Scopus database. Scopus, is a large abstract and citation database, a product of Elsevier containing more than 22,000 titles from publishers worldwide and accepted as popular databases for bibliometric analysis of scientific publications (Shi *et al.*⁷, 2020; Yeung *et al.*⁸.2018) The previous studies do not indicate any study on scientometric assessment of fisheries research in SAARC nations that too including literature from 1994 till 2021 (Date of Extraction of data: 23rd March 2021). The study is conducted including the year 2021 as this year includes exactly 36 publications which are essential to analyse research output in any discipline to obtain reliable results. Among the SAARC nations, two countries (Afghanistan and Bhutan) are excluded from this study because no data was found related to these two countries in Scopus. Further, the study is also limited during the time frame of 1994 to 2021 and literature published in the English language only because the majority of the research publications are published in this language.

4. OBJECTIVES

- To analyse the chronological growth pattern of output in the field of fishery science
- To highlight the most productive author and journal based on performance indicators h-index and g-index
- To calculate the Relative Citation Impact (RCI) and Absolute Citation Impact (ACI) of the SAARC nations
- To visualise the co-authorship network of the authors, evaluate Degree of Collaboration (D_c)
- To evaluate the correlation between h-index and g-index

4.1 Hypothesis

4.1.1 Hypothesis 1

H_{a0} : No significant correlation exists between h-index and g-index in authors.

H_{a1} : Significant correlation exists between h-index and g-index in authors.

4.1.2 Hypothesis 2

H_{b0} : No significant correlation exists between h-index and g-index in journals.

H_{b1} : Significant correlation exists between h-index and g-index in journals.

5. METHODOLOGY

The study examines the scholarly literature on 'Fishery

Science’ and ‘Fish Biology’ by researchers of SAARC nations through a systematic search of the Scopus database. Research data was collected using an advanced search interface using the search expression

(ALL (“Fishery Science” AND “Fish Biology”) AND (LIMIT-TO (AFFILCOUNTRY, “India”) OR (LIMIT-TO (AFFILCOUNTRY, “Bangladesh”) OR (LIMIT-TO (AFFILCOUNTRY, “Maldives”) OR (LIMIT-TO (AFFILCOUNTRY, “Pakistan”) OR (LIMIT-TO (AFFILCOUNTRY, “Nepal”) AND (LIMIT-TO (PUBYEAR, 1994) OROR LIMIT-TO (PUBYEAR, 2021))).

The search operator “AND” has been used because this conjunction includes all items related to the searched items and without exclusion of important and related papers which would be so in using “OR” operator which may exclude relevant documents in the search results and in return it will affect in the accuracy and precision of the results. The inclusion of all related papers in the search would give a precise and efficient outcome of the data after analysis making the results more reliable. The raw data is exported as CSV files which are analysed and tabulated with software packages. The Biblioshiny (Aria & Cuccurullo⁹, 2017) web interface is a comprehensive tool for science mapping which is used for obtaining the main information of the data. Statistical analysis of data and graphical presentation (scatter plot) is done with MS-Excel, network visualisation in data is conducted with VOSviewer (developed at Leiden University’s Centre for Science and Technology Studies, Leiden, Netherlands) which provides reliable results after analysis of the raw data. VOSviewer (Van Eck & Waltman¹⁰ 2010), a tool for bibliometric mapping is widely used in scientometric studies for preparing network maps of bibliographic data with data from Scopus, Web of Science, Dimensions, and PubMed.

h-index as developed by Jorge Hirsch¹¹ in 2005 has number of disadvantages. Keeping this in view a new index called g-index Leo Egghe¹² in 2006 came out with a new index called g-index. It is the resultant of the definition of h-index that the top-*h* papers have minimum *h*² citations but that it is real that the actual number can be much higher (this was missing in h-index). So, the determination of the relationship between these two performance indicators forms very relevant in this study. From this it can be emphasised the extent to efficiency of the g-index is relevant over the h-index.

5.1 Relative Citation Impact and Absolute Citation Impact

Relative Citation Impact (RCI) quantifies both the impact and visibility of research credited against a nation to the global perspective.

$$RCI = \frac{\text{A Country's share of world citation in the speciality}}{\text{Country's share of world publication in the speciality}}$$

Absolute Citation Impact (ACI) is calculated as the average number of citations per publication, so this also called Citation Per Paper, expressed as,

$$\text{Absolute Citation Impact} = \frac{\text{Total Number of Citations}}{\text{Total Number of Publications}}$$

Kumari¹³ applied RCI in a study comparing research performance of different countries to the global outputs.

6. DATA ANALYSIS

A total of 1190 records retrieved from the Scopus database on Fishery Science literature published from 1994 to 2021 is the data for the study. The maximum of the documents are journal articles, followed by reviews, book chapters, conference papers, book, notes, erratum, short surveys. Of the total papers, 1047 are published as journal articles (87.98 % share) which takes the maximum share, followed by 104 papers published as reviews (8.74 % share) are the majority of forms of publications. The publications receive 14.76 average citations per document. With a total of 4784 authors that appear in all the publications, the majority of them work on collaboration. The number of is only 74 while the number of documents with multiple authors (2 or more) is 7203.

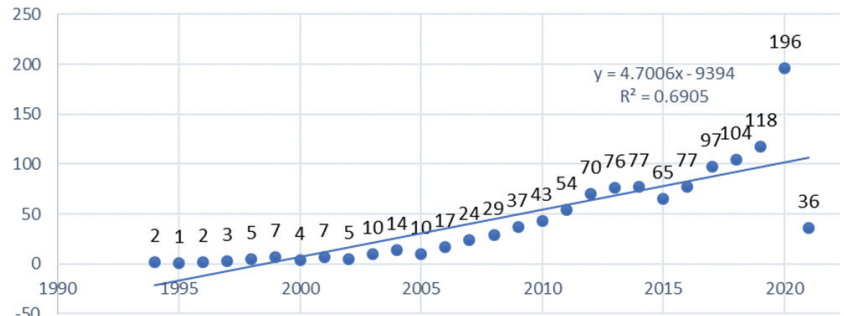


Figure 1. Growth of Publication.

6.1 Growth Rate of Literature

The data is presented with a scatter plot and a linear regression trend line is added displaying the value of *r*² in the plot (Fig. I). The value of *r*² which is approximately equal to 1 (i.e. *r*² ≈ 1) meant that the growth of literature is highly consistent in the study period. Again, the slope of the data is calculated to be 4.700602 which implies that the growth of articles over the study period is 4 articles per year, which is very consistent. The number of publications during the initiation years that are covered in this study is very low but from 2004 onwards it takes a two-digit number from single-digit ones. From 2010, there is a consistent increase in the number of publications though there is a decrease of 10-15 publications in 2015. From 2016, the productivity accelerated and by 2018 it reached a three-digit number (104), by 2020 it reached a peak of 196 publications which is the highest of all.

6.2 Prolific Author

Table 1 presents a list of authors who have at least ten or more than ten publications in their name during the period of study. The ceiling of ten contributions has been taken into account to avoid a long list. Khan, MA is found to be the author with the highest number of publications (35) but Harikrishnan, R is the most influential author (g-index = 27) with 1100 total

Table 1. Most Prolific Author

Author	NP*	TC**	PY_Start	h-index	g-index	Author	NP*	TC**	PY_Start	h-index	g-index
Khan MA	35	483	2004	12	21	Ahmed I	13	112	2007	5	10
Harikrishnan R	27	1100	2005	16	27	Homechaudhuri S	13	34	2009	4	5
Sahu NP	26	437	2007	10	20	Hossain MY	13	98	2012	6	9
Kumar S	24	2763	2006	10	24	Amarasinghe US	12	63	1996	5	7
Lakra WS	24	295	1998	9	16	Ghosh K	12	574	2008	11	12
Balasundaram C	22	1073	2005	16	22	Jaiswar AK	12	67	2011	3	8
Gopalakrishnan A	22	165	2006	7	12	Kumar V	12	172	2011	7	12
Sarkar UK	21	130	2010	6	11	Srivastava PP	12	48	2012	5	6
Pal AK	19	363	2007	9	19	Basheer VS	11	135	2006	6	11
Chakraborty SK	18	93	2009	6	9	Hossain MS	11	226	2015	7	11
Heo M-S	17	912	2009	14	17	Kunal SP	11	95	2012	6	9
Rahman MM	17	87	2008	5	9	Miyan K	11	92	2011	6	9
Ray AK	17	691	1999	12	17	Pandian TJ	11	151	1999	9	11
Das P	16	172	2012	5	13	Singh A	10	56	2011	4	7
Jena JK	16	197	2008	6	14	Singh RK	11	88	2007	6	9
Khan S	15	135	2009	7	11	Haniffa MA	10	76	2004	6	8
Dey S	11	36	2011	4	5	Kim J-S	10	2741	2009	8	10
Lal KK	15	171	2007	7	13	Raghavan R	10	141	2015	7	10
Das BK	14	34	2013	3	5	Roy S	10	112	2006	4	10
Kumar R	14	2640	2012	7	14	Sahoo PK	10	1269	2002	7	10
Mohindra V	14	167	2007	7	12	Siddik MAB	10	87	2015	6	9

NP* = Number of Publications, TC** = Total Citations

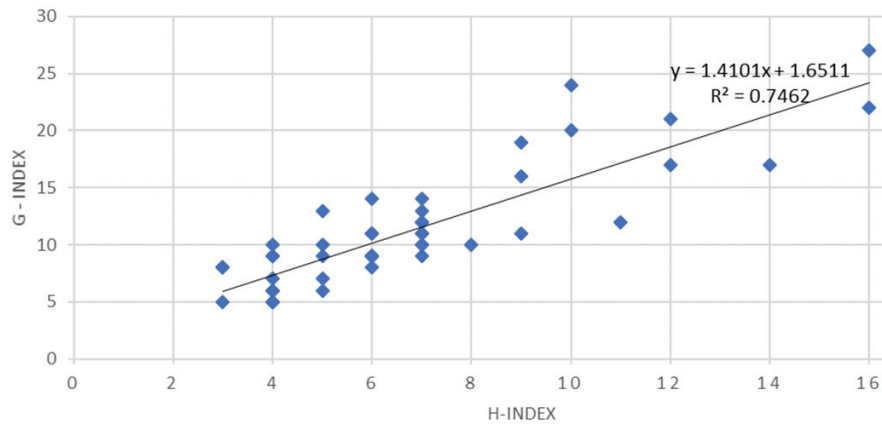


Figure 2. h-g scatter plot prolific authors in Fishery Science and Fish Biology.

citations in 27 publications. Kumar, S is in the second rank as per g-index is concerned with 2763 total citations in 24 publications. Some authors even with a higher number of total citations have a relatively low impact as per the h-index or g-index parameter. For instance, Kim J-S who has 2741 citations after Kumar, S has h-index and g-index as 8 and 10 respectively in ten publications. Likewise, Balasundaram, C has 16 and 22 as h-index and g-index respectively with 1073 total citations in 22 publications. Figure 2 depicts a scatter plot of authors as per h-index and g-index. The h-g scatter plot implies the existence

of a linear relationship between h-index and g-index of authors with a positive correlation ($r^2 = 0.7462 \approx 1$). The two variables satisfy the equation $y = mx + c$ (here $1.4101x + 1.6511$).

6.3 Prolific Journal

Annexure I reveals that a journal may publish many articles but the impact of the articles may not be much. The 1190 publications from SAARC countries on Fisheries research were published in 1047 journals, 104 reviews, 23 book chapters, 5 conference proceedings, 5 books. The list of top 50 sources with at least 5 publications from SAARC countries is given in Table

3. Suppose, in the study the journal namely, ‘Aquaculture Research’ has 66 publications in the period of study but the impact of articles is lower than the Journal ‘Aquaculture’ with 63 publications. The former has 1536, 15, and 38 and the latter have 1698, 23, and 40 as total citations, h-index, and g-index respectively. Likewise, ‘Indian Journal of Geo-Marine Sciences’, ‘Journal of Applied Ichthyology’, ‘Journal of Fish Biology’ have an identical number of publications (22) but interestingly ‘Journal of Fish Biology’ has ranked first in terms of a total number of citations, h-index, and g-index which reflects

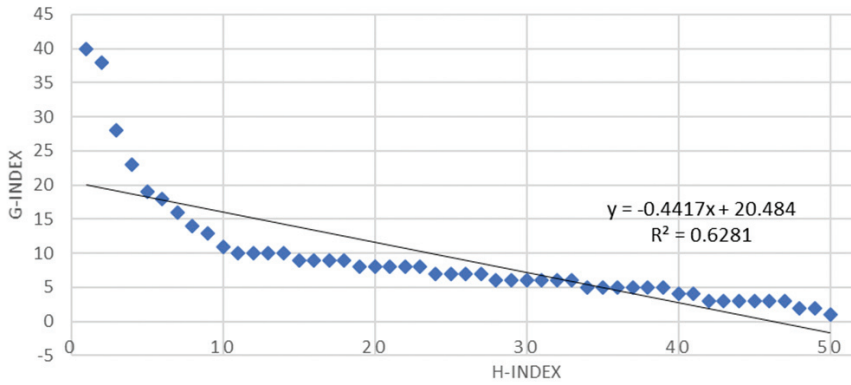


Figure 3. h-g scatter plot for the prolific journal in Fishery Science and Fish Biology.

Table 2. Total citation, world share of total citation and RCI: 1994-2021

Country	Publication	World (%) share of publications	Citation	World (%) share of citations	RCI	ACI
India	904	75.97	8164	92.56	1.22	9.03
Bangladesh	147	12.35	304	3.45	0.28	2.07
Pakistan	83	6.97	234	3.65	0.52	2.82
Sri Lanka	44	3.7	98	1.11	0.3	2.22
Maldives	08	0.67	20	0.23	0.34	2.5
Nepal	04	0.34	0	0	0	0

Table 3. Top 10 collaborated authors in Fishery Science

Rank	Author	Cluster	NP	Citations	TLS
1	MA Khan	26	32	442	41
2	R Harikrishnan	27	27	1100	80
3	NP Sahu	7	26	437	99
4	WS Lakra	16	24	295	72
5	S Kumar	7	23	223	64
6	A Gopalkrishnan	14	22	165	90
7	C Balasundaram	27	22	1073	68
8	UK Sarkar	8	21	130	105
9	AK Pal	22	19	363	74
10	SK Chakraborty	11	18	93	73

*TLS- Total Link Strength

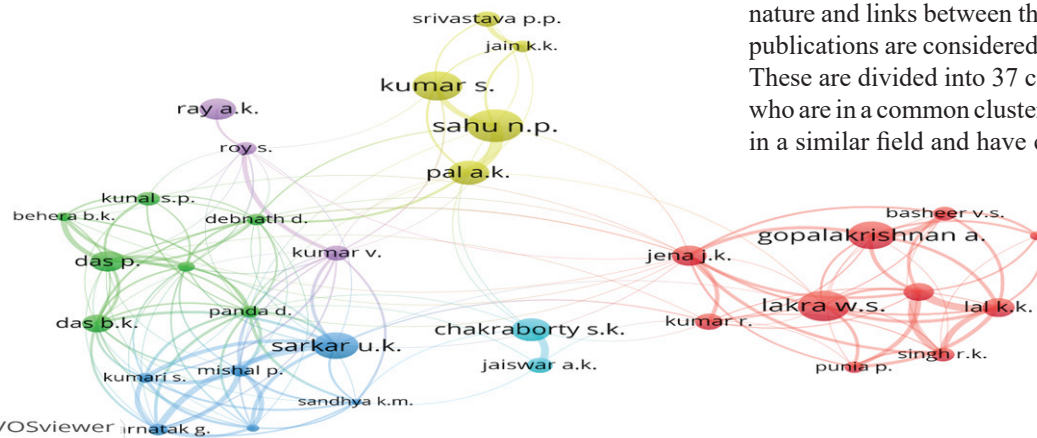


Figure 4. Co-authorship Network (Top 40 authors).

its impact in the discipline, followed ‘Journal of Applied Ichthyology’ and ‘Indian Journal of Geo-Marine Sciences. Figure 3 presents the h-g scatter plot of the journals in the study. The plot indicates the existence of a linear relationship between the h-index and the g-index with a linear trendline. The linear trendline implies that the values of h and g-indices are inversely proportional to one another meaning that an increase in the value of the h-index coincides with a decrease in the g-index. The value of $r^2 = 0.6281 (\approx 1)$ indicates the fitness of actual data to estimated trendline values.

6.4 Relative Citation Impact and Absolute Citation Impact

Table 2 depicts world share publications, citation, RCI, and ACI of the SAARC nations which reveals that India has the highest world share of publications amounting to 75.97 per cent and it is also highest in the share of citations 92.56 per cent of the total citation. Likewise, India has $RCI > 1$ which implies that India has a higher citation impact than the world average rate. Table 2 also reveals the absolute impact of publication in which India tops ($ACI = 9.03$), interestingly Pakistan with a smaller

number of publications than Bangladesh have more ACI (2.82) than Bangladesh ($ACI = 2.07$) meaning Pakistan being in 2nd position follows India concerning ACI. These are followed by Maldives ($ACI = 2.5$) and Sri Lanka ($ACI = 2.22$).

6.5 Visualisation of Co-authorship Network and Evaluating Degree of Collaboration (D_c)

Network visualisation of authorship in the field of Fish Biology research is prepared with VoSViewer software and depicted in Figure 4. An author is represented by a coloured circle (node). The size of the circle is proportional to the number of papers published by an author. The link connecting two circles represents the cooperative relations between the two authors and the thickness of the link represents the strength of cooperation. Figure 5 presents a clear picture of the network between the authors showing their co-authorship nature and links between them. The authors having at least two publications are considered and 789 authors met this threshold. These are divided into 37 clusters of different colours. Authors who are in a common cluster imply that the authors have worked in a similar field and have close cooperation with one another.

The highest number of 71 authors are in Cluster 1 (red color) followed by Cluster 2 (green color) with 44 authors, Cluster 3 (blue color) with 44 authors, Cluster 4 (yellow) with 39 authors. The top ten authors with a minimum of 18 papers in collaboration are listed in Table 3.

6.6 Degree of Collaboration (D_c)

This is a measurement of calculating the proportion of single and multi-authored papers and to elucidate it as an extent or degree of the collaborative attitude of authors in a subject. The expression for calculation of Degree of Collaboration (D_c) was propounded by Subramanyam¹⁴ in 1980 as,

$$D_c = \frac{N_m}{N_s + N_m}$$

where, N_m = Number of Papers multi-authored and N_s = Number of Papers with single author (Table 6).

D_c lies in [0,1]. When all papers are single authored then D_c is 0, otherwise, it is between 0 to 1 when papers are multi-authored as well as single-authored and it is 1 when there are only multi-authored papers but no single-authored paper. Table 4 gives quantity of multi-authored and single-authored papers with the degree of collaboration in the papers.

Table 4. Degree of Collaboration (D_c)

N_s	N_m	N_s+N_m	D_c
34	4750	4784	0.99

Table 5. Correlation between h-index and g-index between authors and journals

Category	Correlation Coefficient (r)	Degree of Freedom (df)	Observed / Calculated value of t (two-tailed)	Critical/ Table Value of t	Significance
Authors	0.939	4783	-15.775	1.960	Significant
Journals	0.966	353	-5.573	1.966	Significant

6.7 Hypothesis Testing

The correlations between h-index and g-index of authors and journals are investigated using Karl Pearson correlation coefficient. The significance is calculated using paired t-test. The results of the test are depicted in Table 5.

6.7.1 Table 5 Indicates

- Correlation Coefficient in both cases i.e., Author and Journal are close to +1 implying existence of a strong linear correlation between the h-index and g-index of authors and journals
- The correlations in both cases are found to be significant.

Therefore, the asserted null hypotheses H_{a0} and H_{b0} are rejected. Hence, the alternate hypotheses H_{a1} and H_{b1} are accepted. This means that the correlation between the h-index and g-index between authors and journals is significant.

7. DISCUSSION

Analysis of chronological research output is an indispensable part of the scientometric assessment. The findings of the study have shown that the field of fisheries research has an upward trend in the number of publications over the study period. During the past few years, the global production of

publications in fisheries has increased significantly. For instance, in 1994 only 2 articles were recorded compared to 2020 with 196 articles (Fig. 1). Relatively, there is a rise in the number of publications by 99 per cent during 1994-2020. This implies an increase in global research activity with an increase in the involvement of human resources. Performance and academic status of a scientist is evaluated usually with the indicator h-index. There are a lot of studies that have recognised it as a beneficial and reliable indicator for estimating the research output and impact of a country, institution, journal, or author. Balasundaram, C and Harikrishnan, R are the authors with the highest h-index (Table 1). *Aquaculture* is the journal with the highest h-index (Annexure I). RCI gives a picture of a country's performance in any research discipline as it is the ratio of the world share of a country's citation to the share of publications while ACI is the ratio of total citations and total publications. The higher the value of RCI and ACI means the higher is the impact of a country in the world and the higher the impact of an author, country, or journal respectively. India ranks top in the RCI and ACI values among the SAARC nations indicating the high impact of Indian publications in Fisheries research (Table 2). High RCI of India also indicates the maximum share taken by India on the number of publications and total citations.

For journals, *Aquaculture Research*, *Aquaculture*, *Fish Physiology and Biochemistry*, *Indian Journal of Fisheries*, *Fish and Shellfish Immunology* published most articles on Fish Biology (Annexure I). These journals with an average of h-index more than 10 are with high impact factor journals publish articles of high quality and so these papers are highly cited papers which in turn raise the scientific influence of these journals. These journals are also leaving ample scope to get a view of future development in this field through these journals. Co-authorship

analysis reflects the research cooperation and existence of relation among the co-authored documents. Here it is applied to evaluate the cooperation between authors. The TLS indicator is a measure of the strength of cooperation among the authors. For author co-authorship analysis, MA Khan is the author with the highest publications, followed by R Harikrishnan (Table 3). The extent of collaborative attitude among the authors and measure of the proportion of single and multi-authored papers is given by degree of collaboration. Here, it is evaluated to be 0.99 indicating the existence of both single and multi-authored papers in the data set. The h-g scatter plots for authors and journals indicate the existence of a linear relationship between the two variables. The linear relationship between h-index and g-index in authors is positive while that in journals is negative. The correlation between different research performance metrics like h-index, g-index implies the relations among those. The correlation between the h-index and the g-index of authors and journals is significant. The positive linear relationship between the h-index and g-index of authors indicates that in an increase in the value of the h-index there is a subsequent increase in the value of the g-index. While there exists a negative linear relationship between h-index and g-index in journals implies that increase in one result in a decrease of another.

8. CONCLUSIONS

In a nutshell, from the findings it has been observed that the number of publications from India is relatively more than other SAARC countries. The study systematically analysed the global research trends on Fisheries overusing the Scientometric method which highlights the researcher's work with panoramic knowledge in this field providing insight to impact of the authors and journals based on performance indicators like h-index, number of publications, total citations, and g-index. The co-authorship analysis of authors indicates the extent of cooperation between them. The highly productive authors also find the name in the list of top authors who are in collaboration. The degree of collaboration ($D_c = 0.99$) also indicates the majority of multiple-authored papers in the data set. The study shows a trend of gradual growth in contributions with a growth rate of 4 articles per year (approx.) with a highly consistent growth of literature ($r^2 \approx 1$). An amalgamated approach from the government on the training of human resource and procurement of latest equipment for conducting research at the molecular level of fish anatomy will lead to a spurt in Fish Biology and Fishery Science Research as evident from the present study SAARC nations like Maldives, Nepal, and Bhutan are lagging behind in this aspect. India is developing in this prospect but the present financial crunch in the Indian economy faced by the country could have a negative impact on the progress attained so far.

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Annexure I**Most Prolific Source**

Journal Name	NP	TC	PY_Start	h-index	g-index
Aquaculture Research	66	1536	1994	15	38
Aquaculture	63	1698	2001	23	40
Fish Physiology and Biochemistry	39	579	2001	13	23
Indian Journal of Fisheries	32	61	2009	5	6
Fish and Shellfish Immunology	28	1007	2002	16	28
Turkish Journal of Fisheries and Aquatic Sciences	27	120	2008	6	9
Indian Journal of Geo-Marine Sciences	22	41	2014	4	6
Journal of Applied Ichthyology	22	194	2007	9	13
Journal of Fish Biology	22	396	2000	9	19
Aquaculture Nutrition	18	629	2004	9	18
Asian Fisheries Science	18	24	2009	2	3
Indian Journal of Animal Sciences	18	78	1998	5	8
Aquaculture International	17	283	1999	10	16
Journal of Applied Aquaculture	16	104	2001	7	10
Journal of Environmental Biology	16	85	2001	6	8
Pakistan Journal of Zoology	16	55	2004	4	6
Iranian Journal of Fisheries Sciences	15	36	2010	3	5
Acta Ichthyologica Et Piscatoria	14	108	2004	7	10
Proceedings of the Zoological Society	14	74	2014	3	8
Reviews in Fisheries Science and Aquaculture	14	236	2014	10	14
Regional Studies in Marine Science	11	13	2018	2	3
Reviews in Aquaculture	11	307	2011	7	11
Ecology, Environment and Conservation	10	5	2003	1	2
Fisheries Research	10	180	1995	7	10
Sains Malaysiana	10	127	2012	6	10
Current Science	9	123	1999	7	9

Annexure I

Most Prolific Source

Journal Name	NP	TC	PY_Start	h-index	g-index
Fisheries Science	9	53	2005	6	7
General and Comparative Endocrinology	9	145	2006	8	9
Molecular Biology Reports	9	149	2009	7	9
Aquaculture Reports	8	54	2015	4	7
Journal of the World Aquaculture Society	8	102	2008	6	8
Reviews in Fish Biology and Fisheries	8	284	2004	7	8
Thalassas	8	15	2016	2	3
Fisheries Management and Ecology	7	74	1996	5	7
Frontiers in Marine Science	7	45	2018	2	6
Mitochondrial DNA	7	37	2013	4	5
PLoS One	7	259	2010	5	7
Proceedings of the National Academy of Sciences India Section B-Biological Sciences	7	23	2012	2	4
Animal Reproduction Science	6	20	2013	4	4
Biochemical Genetics	6	45	2007	4	6
Environmental Biology of Fishes	6	109	2008	5	6
Environmental Science and Pollution Research	6	27	2016	3	5
Indian Journal of Animal Research	6	6	2014	1	2
Mitochondrial Dna Part A: Dna Mapping, Sequencing, and Analysis	6	17	2016	3	3
African Journal of Biotechnology	5	34	2009	3	5
Aquatic Living Resources	5	36	2013	3	5
Biological Rhythm Research	5	11	2015	2	3
Egyptian Journal of Aquatic Biology and Fisheries	5	2	2019	1	1
Environmental Monitoring and Assessment	5	14	2015	2	3
Indian Journal of Marine Sciences	5	46	2001	3	5