

International collaboration among authors of *Current Science*

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International collaboration is becoming more important for modern science. Among others, it is reflected in authorships of scholarly articles. We studied internationality of Current Science based on internationality of its authors. We analysed articles based on their authors, taking into account foreign authors, co-authorship between countries. We did it for various article types as well as all articles taken together, with the help of Web of Science data as well as data from the journal's web page. Most articles (87%) were written by authors affiliated to Indian institutions. Citation analysis of most highly-cited articles based on citation counts and co-authorship patterns showed that only one article from top five articles was internationally co-authored. Word cloud of Current Science titles shows that the journal is focused on India.

Keywords: Bibliometrics, citation patterns, international scientific collaboration, national journals, scientific journals evaluation, word cloud.

In the era of globalization, international status is a quality mark for organizations, industries and science. International collaboration is becoming more and more popular among scientists, and special funding programmes are established worldwide to support such collaborative research. Examples from Europe are the COST (European Cooperation in Science and Technology) framework, which aims to support collaboration among scientists and researchers across Europe, and Horizon 2020, the European Framework Programme for Research and Innovation, which funds research only by international consortia. India collaborates extensively with other governments to fund international research, thanks to UKIERI, British Council India, Indo-German, ICMR-INSERM agreement, and Indo-US agreements; these agreements are targeted mainly to biomedical sciences and education. As a result, science is becoming more and more international. Other contributing factors for development of international collaboration are increasing complexity and specialization of science¹, technological development, and popularization of social networks.

Scientific publications lie at the heart of science². That way, the internationality of co-authorship of publications can reflect the internationality of science³. An international co-publication, considered a result of international

collaboration, is co-authored by at least two authors whose affiliations are from different countries⁴. Various authors conducted research with the aim of quantifying international collaboration patterns of global scientific result⁵⁻⁷. Some studies concentrated on a particular country^{1,8,9}, by analysing the number of articles with authorship at national and international levels. Collaboration between two countries or a group of countries was studied among others by Gupta *et al.*¹⁰, who concentrated on collaboration between India and Russia; Aksnes *et al.*⁴, who studied collaboration patterns among Nordic countries; and Tang¹¹, who focused on collaboration among USA and China in nanotechnology. International collaboration in different scientific disciplines was presented, for example, by Wagner¹², who analysed co-authorship links among researchers in astrophysics, geophysics, mathematical logic, polymers, soil science and virology. Prakasan *et al.*⁹ applied domainary research index (DRI) to measure field-wise intensity of India in internationally published papers.

International collaboration can also be analysed through network structure of co-authorships. Newman¹³, for example, constructed networks of collaboration for mathematics, biomedicine and physics; in their analyses, nodes represented scientists and connections between them represented co-authored papers. Leydesdorff and Wagner⁷ presented an analysis of the global science network. It included countries, co-authored papers and core groups of scientists. The authors also described the density of author network in the world.

International character of science is also reflected in scientific journals. Most reputed journals have international editorial boards, often considered an advantage by scientific community. Editors of new journals often

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underline the internationality of their editorial boards^{14–16}. For business, political science, and genetics journals, Nisonger¹⁷ reported a positive correlation between several indicators of internationality (number of countries represented in the editorial board, number of international members, and share of international board members) with impact factor and total citations in *Journal Citation Reports*.

Internationality of the editorial board, nonetheless, does not have to be a measure of true internationality of the journal. Equally, if not more important is the internationality of the research published in the journal. To some extent, this internationality is represented by the international diversity among authors of the journal. A journal can be international because of papers published by authors representing various countries (wherein, a particular paper is written by authors from one country); it is a different type of internationality than one in which a journal publishes papers that result from international collaboration (in which authors of one paper represent various countries). True international collaboration in science will be reflected by papers co-authored by researchers affiliated to institutions from various countries.

Current Science is an Indian journal. Its editorial board is international, but with most editors being affiliated to Indian institutions. It is often focused on Indian internal issues (which can be seen, for example, in topics taken up in the correspondence articles). Still, the journal is known outside India and is cited in various foreign sources. *But does it publish international research?*

In this article, we aim to answer the question whether *Current Science* publishes papers that result from international collaboration, and if the most cited articles in *Current Science* result from international collaboration. We are aware that *Current Science*'s publication portfolio does not reflect Indian science, and we are not going to make any conclusions about Indian science in general. Our analysis will solely relate to *Current Science*, by which we wish to add to the knowledge of science communication in India.

Methods

To examine the level of international collaboration in *Current Science*, the *Web of Science (WoS)* of Thomson Reuters and webpage of the journal were used. We collected all 2380 articles published in 2002, 2007 and 2012; including correspondence, research communications, book reviews, scientific correspondence, general, review and research articles, news (research, personal and historical notes), commentaries, editorials, opinions, technical notes, research accounts, in conversations, interviews and articles from special sections with a common topic. We encountered two problems: *WoS* omits book reviews and types of articles in *WoS* and *Current Science* differ. So,

information on book reviews and typology of the articles was taken from papers available at the journal's webpage. Six articles authored by *Anonymous* were not used in the analysis.

Based on the affiliations of co-authors, we classified the articles into the following groups: (i) national (authors affiliated to Indian institutions only), (ii) international (authors affiliated to institutions from two different countries), and (iii) foreign (authors affiliated to institutions from one country, other than India).

We analysed how many papers published in *Current Science* from 1945 to 2014 were affiliated to non-Indian institutions. This analysis revealed an error in indexing in the *Web of Science (WoS)* of papers from 1961 to 1972. For years 1961–1972, *WoS* did not include author affiliation, and all unidentified author addresses were marked as not from India. A check of selected articles showed that most of the authors affiliated to Indian institutions were not assigned to India.

We also analysed the titles of articles to discover whether we could point out keywords that are most specific for *Current Science*. With this aim, we constructed a word cloud based on the titles of all articles published in *Current Science* in 2002, 2007 and 2012. Word cloud is a graphical representation of text in which the most frequent words are highlighted by larger font or darker color¹⁸. For this purpose Worditout software was used¹⁹.

Results and discussion

Out of 2380 articles, 1100 had one author while 1280 had two or more authors. Maximum number of authors was 23, in two articles. Only 129 articles were written by authors from two or more different countries; among which, 15 articles were written by authors from 3 different countries. Authors who contributed to the journal during the researched period affiliated to institutions from 53 countries. Indian scholars authored and co-authored 2203 articles, both national (2088) and international (115) ones.

Articles of national authorship constituted the biggest share, accounting for almost 88% (2088) of the articles (Table 1). Those with foreign authorship (with one country, other than India) represented 6.8% (163 articles) of the total, while articles with international authorship (two or more countries) accounted for only 5.4% (129). The results were consistent in the years analysed (Table 1).

Indian authors co-published mainly with authors from the USA (in 33 papers), followed by scientists from France (9 papers), Germany (9 papers), and the UK (8 papers). Most of the 129 internationally co-authored papers were from two countries (4.8% of the total, 114 papers). In only 15 of them, authors were affiliated to institutions from 3 countries. Among them, 12 papers resulted from collaboration between India and two other

GENERAL ARTICLES

Table 1. Number of articles based on authorships for the three years studied

Year	National	Foreign	International	Total
2002	705 (88.2%)	52 (6.5%)	42 (5.2%)	799 (100%)
2007	750 (86.2%)	67 (7.7%)	53 (6.1%)	870 (100%)
2012	633 (89.0%)	44 (6.2%)	34 (4.8%)	711 (100%)
Total (share)	2088 (87.7%)	163 (6.8%)	129 (5.4%)	2380 (100%)

Table 2. Domestic, foreign and international authorship shares distinguished by paper type

Type of paper	No. of records out of 2380	Domestic with one country (India only)	Foreign with one country, besides India	International (papers with more than 1 country)	
				2 Countries	3 Countries
Correspondence	22.8% (542)	90.0% (488)	8.9% (48)	1.1% (6)	–
Research communication	20.5% (488)	86.1% (420)	4.1% (20)	9.2% (45)	0.6% (3)
Scientific correspondence	9.8% (233)	88.0% (205)	6.4% (15)	4.7% (11)	0.9% (2)
General articles (incl. special section)	10.6% (253)	77.5% (196)	15.0% (34)	7.5% (19)	1.6% (4)
Research articles	5.5% (131)	82.4% (108)	6.9% (9)	8.4% (11)	2.3% (3)
Review articles	2.9% (69)	81.2% (56)	5.8% (4)	11.5% (8)	1.4% (1)
Commentary	2.4% (57)	86.0% (49)	8.7% (5)	5.3% (3)	–
Research news	2.4% (56)	92.9% (52)	3.8% (2)	3.8% (2)	–
Opinion	1.5% (36)	83.3% (30)	5.6% (2)	5.6% (2)	5.6% (2)
Technical notes	0.6% (14)	100.0% (14)	–	–	–
Research accounts	0.6% (13)	76.9% (10)	15.4% (2)	7.7% (1)	–
Book reviews	9.9% (235)	96.2% (226)	3.8% (9)	–	–
News	4.2% (101)	96.0% (97)	1.0% (1)	3.0% (3)	–
Personal news	2.4% (56)	94.6% (53)	5.4% (3)	–	–
Editorial	2.0% (48)	100.0% (48)	–	–	–
In conversation	0.8% (19)	84.2% (16)	5.3% (1)	10.5% (2)	–
Historical notes	0.8% (19)	57.9% (11)	36.8% (7)	5.3% (1)	–
Historical news	0.3% (7)	85.8% (6)	14.3% (1)	–	–
Erratum	0.1% (3)	100.0% (3)	–	–	–

countries (the USA, the UK, Sri Lanka and Germany being most frequent). Only 3 of these 15 articles did not include authors from India.

Types of articles

International collaboration is unevenly distributed among types of *Current Science* articles. Some types are traditionally single-authored. Thus, not all contributions should be used to evaluate the internationality of the journal. In the study of research output of Nordic countries, Aksnes *et al.*⁴ analysed research articles, letters and reviews, as defined by *WoS*. Leydesdorff and Wagner⁷, and Persson *et al.*²⁰ examined articles, reviews, letters and notes to evaluate international collaboration in science.

Current Science has 19 article types (Table 2). Correspondence papers, the largest group of papers (22.7%), were dominated by domestic authors in 90% of papers (Table 2). The remaining 10% were mainly of foreign authorship while internationally co-authored ones were rare (1%). Research articles – maybe the most important of *Current Science* articles category – accounted for only 5.5% of all articles. Domestic authorship occurred in over

82% of articles, foreign authorship in 7% while international authorship in 10% of research articles. Three research articles were written by authors from three countries. Scientific correspondence showed similar share of foreign (6.5%) and international (5.5%) authorship. General articles together with special section papers had a significant part of foreign (15%) and international (9%) articles. Review articles had the highest share (13%) of international papers.

Book reviews, news, editorials, in conversation, and historical notes usually are not considered when investigating international collaboration. In our analysis, of the 235 book reviews only 9 were foreign and none was an international collaboration paper (which should not surprise since book reviews are seldom written by over one author). Three news and two in conversation papers were affiliated by authors from different countries.

Citation analysis

According to many studies, papers that result from international collaboration receive more citations than other papers^{8,21–23}. Thus, we analysed five most frequently cited *Current Science* articles, according to *WoS*, from 2002,

Table 3. Citation counts for top 5 *Current Science* articles in 2002, 2007, 2012

Year	Title of the article	No. of author(s)	Type of cooperation	No. of countries	Citation count
2002	Matysik, J., Alia, Bhalu, Mohanty, B., Molecular mechanisms of quenching of reactive oxygen species by proline under stress in plants. <i>Curr. Sci.</i> , 2002, 82 (5), 525–532.	4	International	2	267
	Arora, A., Sairam, R. K., Srivastava, G. C., Oxidative stress and antioxidative system in plants. <i>Curr. Sci.</i> , 2002, 82 (10), 1227–1238.	3	National	1	238
	Biswas, K., Chattopadhyay, I., Banerjee, R. K., Bandyopadhyay, U., Biological activities and medicinal properties of neem (<i>Azadirachta indica</i>), <i>Curr. Sci.</i> , 2002, 82 (11), 1336–1345.	4	National	1	215
	Tiwari, A. K. and Rao, J. M., Diabetes mellitus and multiple therapeutic approaches of phytochemicals: present status and future prospects. <i>Curr. Sci.</i> , 2002, 83 (1), 30–38.	2	National	1	122
	Hait, S. K. and Mouluk, S. P., Gemini surfactants: a distinct class of self-assembling molecules. <i>Curr. Sci.</i> , 2002, 82 (9), 1101–1111.	2	National	1	114
2007	Kulkarni, A. V. <i>et al.</i> , Glacial retreat in Himalaya using Indian remote sensing satellite data. <i>Curr. Sci.</i> , 2007, 92 (1), 69–74.	7	National	1	104
	Laurance, W. F., Forest destruction in tropical Asia. <i>Curr. Sci.</i> , 2007, 93 (11), 1544–1550.	1	Foreign	1	62
	Mohan, S. V., Raghavulu, S. V., Srikanth, S. and Sarma, P. N., Bioelectricity production by mediatorless microbial fuel cell under acidophilic condition using wastewater as substrate: Influence of substrate loading rate. <i>Curr. Sci.</i> , 2007, 92 (12), 1720–1726.	4	National	1	48
	Siva, R., Status of natural dyes and dye-yielding plants in India. <i>Curr. Sci.</i> , 2007, 92 (7), 916–925.	1	National	1	44
	Gunawardene <i>et al.</i> , A brief overview of the Western Ghats, Sri Lanka biodiversity hotspot. <i>Curr. Sci.</i> , 2007, 93 (11), 1567–1572.	11	International	3	33
2012	Kulkarni, J. R. <i>et al.</i> , The Cloud Aerosol Interaction and Precipitation Enhancement Experiment (CAIPEEX): overview and preliminary results. <i>Curr. Sci.</i> , 2012, 102 (3), 413–425.	22	National	1	27
	Jain, S. K. and Kumar, V., Trend analysis of rainfall and temperature data for India. <i>Curr. Sci.</i> , 2012, 102 (1), 37–49.	2	National	1	26
	Giribabu, L., Sudhakar, K. and Velkannan, V., Phthalocyanines: potential alternative sensitizers to Ru(II) polypyridyl complexes for dye-sensitized solar cells. <i>Curr. Sci.</i> , 2012, 102 (7), 991–1000.	3	National	1	22
	Kumar, A. and Bachhawat, A. K., Pyroglutamic acid: throwing light on a lightly studied metabolite. <i>Curr. Sci.</i> , 2012, 102 (2), 288–297.	2	National	1	19
	Paul, A. and Bhattacharya, S., Chemistry and biology of DNA-binding small molecules. <i>Curr. Sci.</i> , 2012, 102 (2), 212–231.	2	National	1	19

The citation analysis was conducted on 3 November 2015, based on *Web of Science* by Thomson Reuters.

2007 and 2012 (Table 3). Only one article in 2002 and one article in 2007 from the top five resulted from international collaboration. One article written by foreign authors in 2007 was among the top five.

From the word cloud based on titles of *Current Science* articles (Figure 1), the most frequently used words in the title of *Current Science* articles are ‘India’ and ‘Indian’, followed by ‘science’ and ‘research’. Names of regions in India are there too (Himalaya, Pradesh, Ghats, Bengal).

Figure 2 shows the share of articles from non-Indian authors from 1973 to 2014, based on *WoS*. We can see that internationalization of *Current Science* is progressing rather slowly.

Conclusions

International collaboration is considered to be a success indicator in business and science. Different approaches

can be used to quantify this phenomenon. In science, co-authorship patterns were examined to identify collaboration patterns for different countries^{1,8,9}, disciplines of science^{9,12} or institutions²⁴.

Current Science is a respected journal in India. To understand its position in the general trend of internationalization of science, we analysed affiliations of authors from articles published in the journal in 2002, 2007 and 2012. The analysis shows that *Current Science* is dominated by Indian authors, irrespective of the article category. Figures 1 and 2 also suggest that, at the moment *Current Science* is not an international journal, or rather that its level of internationality is low. Despite this, *Current Science* is recognized abroad, especially by being cited in various foreign sources by numerous foreign authors. This in turn shows that even a journal whose publications are mostly national can be internationally recognized. Such a journal also has great

