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Citation Analysis of Scholarly Publications on Indigenous Knowledge

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Abstract

Indigenous Knowledge (IK) refers to traditional knowledge that play a key role in the sustainable development of human society. Nowadays, the importance of IK is recognized significantly. We focus on a citation analysis of scholarly publications on IK during 2015-2019. The main contribution of this paper is to highlight the most productive journals; author impact; ranking of cited journals, non-journals, authors, and documents; reference spectroscopy; the shared coupling of articles; and co-citation of cited-authors. The scholarly citation data (n=2000) were collected from the Web of Science database and analyzed using bibliometrics software. The findings reveal that the “Journal of Ethnobiology and Ethnomedicine” is the most productive journal. B. Held is identified as a most impactful author. The highly cited journal and non-journal are “Indian Journal of Traditional Knowledge” and “Decolonizing Methodologies”. This paper also uncovers that “Anonymous authors” are cited most of the time in 2000 articles; the increase in citation is the highest from 21st-century; and the highest shared coupling strength of two articles is 70. Lastly, a co-citation network is visualized to establish the relationship of cited-authors. This paper provides a distinct overview of citation analysis and it can be helpful for both the IK researchers and LIS professionals.

Keywords: Bibliometrics studies, Web of science, Author impact, Reference spectroscopy, Shared coupling, and Co-citation network.

1. Introduction

“Bibliometrics” is a branch of information science and is often used in the field of library and information science. It is the application of mathematics and statistical methods to books and other media of communication¹⁶. There are different methods for analysis depending upon the different sorts of information utilized in bibliometrics studies. The most common techniques are citation-based analysis, co-word analysis or keyword co-occurrence analysis, and co-authorship analysis¹⁰. Citation analysis is one of the most widely used methods in bibliometrics. The word “citation” is used synonymously with the term “bibliographic

reference”¹³. Thus, a citation refers to a relationship between the cited document and the citing document. The study of the relationship is called citation analysis¹⁹. Generally, it is a mathematical analysis of the references affixed at the end of a scientific communication. Analysis of citations helps to evaluate the growth and structure of literature of any discipline. It is the process of collecting, calculating, analyzing, and interpreting citations given in the research paper, and identifying the authentic sources of information⁹. According to Garfield⁵, the “citation analysis” method simplifies the research process, enhances the research results, and studies the history of science. In bibliometrics research, citation databases play a key role to find newer and older information. There are many online citation indexes (e.g. Web of Science, Scopus, and Google scholar etc.) that facilitate searching citations and they are also known as citation analysis tools²⁵.

Plenty of research works on citation analysis have been conducted over the past years to understand the citing behaviour, core citations of an article, impact of authors, quality of publications, and subject relationship etc. Ramesh and Nagaraju¹⁷ pointed out some benefits of citation analysis. Citation analysis explores the citation links between scientific papers and reviews; provides significant proportions of utility and relationships of journals; identifies the core lists of journals; helps in clustering of documents according to common references and citations, and studied the growth rate obsolesces. Baker¹ reviewed different methods of citation analysis that include “counting citations”, “bibliographic coupling”, and “co-word analysis”, author “co-citation analysis”, and “document co-citation analysis” etc. Therefore, he mentioned these methods enable researchers to use in social work, for example, “research management”, “sociology of social work”, and “studying the history of social work”. Another study on citation analysis of scholarly communication in the journal “Knowledge Organization” was carried out by Haridasan and Kulshrestha⁷ to understand the “information needs”, “use patterns” and “use behaviour” of library and information science researchers associated with the knowledge organization. The authors analyzed 2,462 citations and found the average citation number is nearly 21 per article. They also explored that books were the main source of information; the USA, UK, and Germany were the most productive countries; and in the authorship pattern, single-authored was the highest number of citations. Swain and Hussain²⁰ investigated the citation pattern of 495 articles of Computer Science. They retrieved citation data from the ScienceDirect database. They evaluated the authorship patterns, ranking of authors, country productivity, journals, and highly cited papers of Computer Science from 2005 to 2010. Brown and Gardner³ measured the impact of journals and articles on Contemporary Accounting Research (CAR) using citation analysis. The authors evaluated the four major “accounting journals” (The Accounting Review, Journal of Accounting Research, Accounting Organizations and Society, and Journal of Accounting and Economics) to CAR from 1976 to 1982. Their findings of the study showed “Journal of Accounting and Economics” as the highest impact factor journal on CAR. Olatokun and Makinde¹⁴ studied a citation analysis of Masters’ Dissertations submitted to the Department of Animal Science at University of Ibadan, Nigeria. The authors found that most citations are used from journals, they Poultry Science (926) was the highest number of citations followed by Animal Feed Science and Technology (707), Journal of Nutrition (413), Journal of Animal Science (299). Singh and Bebi¹⁸ studied citation analysis of PhD theses of Sociology which

were submitted at University of Delhi during 1995-2001. The authors retrieved 5766 citations from 25 theses which attempted to identify the authorship pattern, forms of literature, country wise, publisher wise scattering of citations, distribution of Indian and foreign citations ranking of core journals of sociology.

The present study deals with different applications of citation analysis to measure the research output of scholarly publications on Indigenous Knowledge (IK). IK is a unique knowledge of a particular culture or society²¹, and generated from the experience of local communities over the centuries and adapted to their own agro-ecosystems and socio-economic environments. It is defined as undocumented tacit knowledge. Due to the tacit nature of IK, it is transmitted orally from one generation to another in various forms such as stories, proverbs, beliefs, folklore, rituals, cultural values, songs, art, and agricultural practices⁶. IK is closely related to culture and biodiversity, and its role in the conservation and sustainable development of global biodiversity is unparalleled.

2. Objectives of the study

The objectives of the study are as follow:

- To show the different types of the documents published under the context of Indigenous Knowledge (IK);
- To identify the highly productive journals of IK;
- To measure the authors' impact regarding their publication;
- To determine the total no of articles and their citations;
- To find the highly cited references (journals and non-journals);
- To reveal the highly cited authors and corporate authors(based on cited references);
- To show ranked list of cited documents;
- To present the reference spectroscopy of publication year;
- To measure countries' citation counts;
- To analyze the shared coupling units; and
- To map the co-citation network of cited authors.

3. Methodology

3.1 Data collection

The required data for this study was collected from the Clarivate Analytics Web of Science (WoS)²⁴ core collection database. We employed the following search criteria:

- Search type: Basic Search
- Search Term: "Indigenous Knowledge"
- Time Span: 2015-2019
- Language: English
- Document refinement (Document type): Articles

Since the all setting was done, we downloaded 4 plain text (.txt) files that contain citation data of 2000 articles. Section 3.2 reveals the further processes.

3.2 Data processing

We have used BibExcel as the prime tool for this particular study. It is a freeware package for analyzing bibliographic data¹⁵. We also have used spreadsheets for preprocessing and sorting purposes. First, we imported the downloaded files into BibExcel and then converted the files into a single DOC-file (.doc). Second, we executed the data matrices using the DOC file. Third, we made an OUT-file for analyzing the cited references. Then, we used different BibExcel files (e.g. CIT-File and COU-file etc.) to discover highly productive journals, most cited authors, ranking of cited references, and shared coupling units, etc. Lastly, we visualized a cited author co-citation network (NET-file) with Pajek.

3.3 Data Analysis

The citation data set contains a full list of metadata that include authors(AU), source(SO), document types(DT), titles(TI), cited documents(CD), publication year(PY), reprint address(RP), number of references(NR), and times cited(TC), etc. In particular, we analyzed the CD, AU, NR, and TC as target data tags²² in BibExcel for presenting a quantitative overview (can be *seen* from Section-4).

4. Results

4.1 Document types 2000 citation data

Table 1: Different document types

| Document Type | No. of Articles | % |
|--------------------|-----------------|------|
| Journal articles | 1922 | 96.1 |
| Book chapter | 2 | 0.1 |
| Early access | 38 | 1.9 |
| Proceedings papers | 38 | 1.9 |

n=2000

[Data retrieved on 19/07/2020]

Table 1 introduces the document type which is divided into four categories: one is the journal articles; second is articles in book chapters; third is early access articles, and four is conference proceedings. This table shows 96.1% of documents are journal articles while 0.1% of articles belong to book chapters followed by early access articles (1.9%) and conference proceeding papers (1.9%).

4.2 Highly productive journals of IK indexed in WoS

Table 2: Highly productive journals

| Name of the Journal | Total Publications |
|---|---------------------------|
| Journal of Ethnobiology and Ethnomedicine | 51 |
| Indian Journal of Traditional Knowledge | 40 |
| Sustainability | 38 |
| South African Journal of Botany | 24 |
| PLOS One | 23 |
| Journal of Ethnopharmacology | 21 |
| Journal of Ethnobiology | 19 |
| Ecology and Society | 19 |
| Human Ecology | 17 |
| Cultural Studies of Science Education | 16 |

***R: Rank**

In citation analysis or other bibliometrics studies, the measurement of highly productive journals is one of the most important parts for uncovering the impact of the journals. There are total 968 journals and Table 2 shows top 10 highly productive journals. This table also reveals the obvious form of the list of journals that are authored by researchers. It evinces that the 'Journal of Ethnobiology and Ethnomedicine' is the most impactful journal. Authors from different regions contributed to a total of 51 articles in the journal. 'Indian Journal of Traditional Knowledge' is the second-highest productive journal with 40 publications followed by 'Sustainability' (38), 'South African Journal of Botany' (24), 'PLOS One' (23), 'Journal of Ethnopharmacology' (21), 'Journal of Ethnobiology' and 'Ecology and Society' (19), 'Human Ecology' (17), 'Cultural Studies of Science Education' (16), and a total of 1732 articles were published in other 958 different journals.

4.3 Measuring the research impact of authors

Table-3 Data table of top 10 authors

| Author's Name(with 1st Initial) | TC* | R |
|--|------------|----------|
| Held B. | 23 | 1 |
| Uduji J. | 12 | 2 |
| Schuster R | 12 | 3 |

| | | |
|------------|----|----|
| Oswin N. | 11 | 4 |
| Azzurro E. | 10 | 5 |
| Ganyaglo S | 10 | 6 |
| Giovas I. | 9 | 7 |
| Lyver P. | 8 | 8 |
| Singh P. | 6 | 9 |
| Pecl G. | 6 | 10 |

**TC: Times Cited*

Table 3 shows the list of authors ('contributors') names alongside the maximum number of citations of their respective papers. There are 7702(as per WoS dataset) authors who have contributed in 2000 documents. Here the top 10 authors got the most noteworthy citations as depicted in BibExcel. B. Held is the most impactful author. He has been cited 23 times (until the WoS data was retrieved). J. Uduji (12) and R. Schuster (12) have ranked 2nd together followed by N. Oswin(11), E, Azzurro(10) and S. Ganyaglo(10), I. Giovos(9), P. Lyver(8), P. Sing(6), and G. Pecl(6).

4.4 Total citations of 2000 articles

Table 4: Data table of total citations of 2000 articles

| Total Citations | No of articles | % |
|-----------------|----------------------|-------|
| 0 | 683 | 34.15 |
| 1 | 405 | 20.25 |
| 2 | 253 | 12.65 |
| 3 | 188 | 9.4 |
| 4 | 123 | 6.15 |
| 5 | 100 | 5 |
| 6 | 55 | 2.75 |
| 7 | 50 | 2.5 |
| 8 | 31 | 1.55 |
| 9 | 14 | 0.7 |
| 10 | 24 | 1.2 |
| >10 | 74 | 3.7 |
| Total | <i>n=2000</i> | |

As the articles were contributed in-between 2015 and 2019, Table 4 shows the total number of citations of the 2000 articles up to 2019. Most of the articles (34.15%) found with 0 citations. Next 20.25% articles have 1 citation followed by 12.65% articles with 2 citations, 9.4% articles with 3 citations, 6.15% articles with 4 citations; and 5% articles with 5 citations. It likewise has been uncovered that 105(5.25%) articles have 6-7 citations, while 31(1.55%) articles have 8 citations and 24(1.2%) articles have 10 citations. Besides, just 9 citations are found barely in 14(0.7%) articles, and more than 10 citations are found in 74(3.7%) articles.

4.5 Ranking of cited journals and non-journals

Table-5: Data table of top 10 cited journals and non-journals

| Journals | TC | R | Non-journals | TC | R |
|---|-----|----|-----------------------------------|----|----|
| Indian Journal of Traditional Knowledge | 286 | 1 | Decolonizing Methodologies (1999) | 79 | 1 |
| Arctic | 173 | 2 | Decolonizing Methodologies (2012) | 62 | 2 |
| Pakistan Journal of Botany | 163 | 3 | Res is Ceremony India (2017) | 42 | 3 |
| Decolonization | 119 | 4 | Sacred Ecology | 36 | 4 |
| Journal of Medicinal Plants Research | 105 | 5 | Red Skin White Masks (2014) | 32 | 5 |
| Ecological Application | 73 | 6 | Plants Indigenous Me (1996) | 29 | 6 |
| Canadian Journal of Native Education | 59 | 7 | Indigenous Methodology (2009) | 28 | 7 |
| Arctic Anthropology | 53 | 8 | Native Science (2000) | 27 | 8 |
| African Journal Biotechnology | 52 | 9 | Braiding Sweetgrass | 23 | 9 |
| Current Science India | 51 | 10 | Pedagogy Oppressed | 22 | 10 |

Table 5 covers the ranking of highly cited journals and non-journals. First, it shows the top 10 journals that are at least 50 times cited. 'Indian Journal of Traditional Knowledge'(India) is the most prominent journal which has a total of 286 citations. 'Arctic Journal' (173), 'Pakistan Journal of Botany'(163), 'Decolonization' (119), and 'Journal of Medicinal Plants Research' (105) are the other highly cited journals. Secondly, the table indicates the list of the highly cited non-journals. It clearly shows the top 10 highly cited non-journals that are at least 20 times cited. The 'Decolonizing Methodologies'(1999 and 2012) is the most cited non-

journal(s) which has more than 140 citations. Three other leading non-journals are 'Res is ceremony India' (42), 'Sacred Ecology'(36), and 'Red Skin White Masks' (32).

4.6 Ranking cited authors and corporate authors

Table- 6 Data table of top 10 cited authors

| Name of authors(with 1st and 2nd initial)/corporate authors | TC | R |
|--|-----------|----------|
| Anonymous | 1282 | 1 |
| Berkes F. | 255 | 2 |
| Ford JD | 128 | 3 |
| Reyes-Garcia V | 115 | 4 |
| Turner NJ | 114 | 5 |
| Berkes F. | 110 | 6 |
| World Health Organization | 96 | 7 |
| Agrawal A | 92 | 8 |
| FAO | 83 | 9 |
| UNESCO | 81 | 10 |

Table 6 shows the top 10 highly cited authors and corporate authors. It indicates that Anonymous authors have been cited 1282 times. Papers with unspecified authors or corporate authors are indexed in Web of Science Core Collection as “Anonymous”²³. F. Berkes ranks (2nd and 6th) twice in the list. He has been cited 365 times followed by J. D. Ford (128), V. Reyes-Garcia (115), N. J. Turner (114), and A. Agarwal (92). On the other hand, corporate authors viz. The World Health Organization (WHO), FAO, and UNESCO have been cited respectively 96, 83, and 81times.

4.7 Ranking cited document

Table 7: Data table of highly cited document (at least 30 times cited)

| Documents | TC | R |
|--|-----------|----------|
| Smith L.T., 1999, Decolonizing Methodologies | 79 | 1 |

| | | |
|--|----|----|
| Berkes F, 2000, V10, P1251, EcolAppl, Doi 10.1890/1051-0761(2000)010[1251:Roteka]2.0.Co;2 | 73 | 2 |
| Smith LT, 2012, Decolonizing Methodologies | 62 | 3 |
| Braun V., 2006, V3, P77, Qualitative Res Psyc, Doi 10.1191/1478088706Qp063Oa | 47 | 4 |
| Agrawal A, 1995, V26, P413, Dev Change, Doi 10.1111/J.1467-7660.1995.Tb00560.X | 47 | 5 |
| Tuck E, 2012, V1, P1, Decolonization | 46 | 6 |
| Wilson S., 2008, Research is ceremony: Indigenous research methods | 42 | 7 |
| Tengo M, 2014, V43, P579, Ambio, Doi 10.1007/S13280-014-0501-3 | 42 | 8 |
| Huntington HP, 2000, V10, P1270, EcolAppl, Doi 10.1890/1051-0761(2000)010[1270:Utekis]2.0.Co;2 | 37 | 9 |
| Berkes F., 2012, Sacred Ecology | 36 | 10 |
| Gadgil M, 1993, V22, P151, Ambio | 35 | 11 |
| Ens EJ, 2015, V181, P133, BiolConserv, Doi 10.1016/J.Biocon.2014.11.008 | 34 | 12 |
| Coulthard G., 2014, Red Skin White Masks | 32 | 13 |
| Wolfe P, 2006, V8, P387, J Genocide Res, Doi 10.1080/14623520601056240 | 30 | 14 |

[Articles can be retrieved by using DOI]

In the Table 7, there is a list of highly cited documents (at least 30times) that incorporate journal articles and books. This table shows that a blend of 5 books and 9 journal articles are cited mostly by the authors. “Decolonizing Methodologies (PY: 1999&2012)” by L.T Smith is being recognized as the topmost cited book (152 citations) followed by the books ranked sixth (46), tenth (36), and thirteenth (32). An article “Rediscovery of traditional ecological knowledge as adaptive management (2000)” by F. Berkes is perceived as the second highly cited document followed by articles contributed by V. Braun (47), A. Agarwal (47), E. Fold (46), M. Tengo (42), H.P. Huntington (37), M. Gadgil (35), E.J. Ens (34), and P. Wolfe (30).

4.8 Reference spectroscopy

Marx et al.¹² introduced a quantitative method named “Reference Publication Year Spectroscopy (RPYS)” for identifying the historical roots of research and quantifying their impact on current research. It gives a distinctive view of past literature. For this present study, we have arranged the data table (see Table 8) according to the spectroscopy of reference

publication years. We have diminished the class interval of period by 100 years (century based) for better understanding.

Table-8: Data table of cited years from 1500 to 2019

| Period | Total Citation | % |
|--------------------------------------|----------------|-------|
| 1500-1599(16th Century) | 39 | 0.03 |
| 1600-1699(17th Century) | 63 | 0.05 |
| 1700-1799(18 th Century) | 186 | 0.16 |
| 1800-1899(19 th Century) | 810 | 0.69 |
| 1900-1999(20 th Century) | 20557 | 17.42 |
| 2000-2019(21 st Century*) | 96380 | 81.65 |
| n= 118035 | | |

The data in the Table 8 shows the timeline of those cited documents that were published from 1500 to 2019. The period from 1500 to 1799 has a lower citation rate. The total citations of 3 centuries are 288(0.24%). The 19th century saw a gradual increase in citation (0.16%). A significant increase of citation is observed in the 20th century (1900-1999) which saw a total of 20557(17.42%) citations. The majority of citations (81.65%) belong to 2000-2019. Most of the authors preferred to cite those papers that were published in the last 20 years. They found the most relevant literature that matched with their research. Figure 1 gives a presentation of the exponential trendline of RPYS.

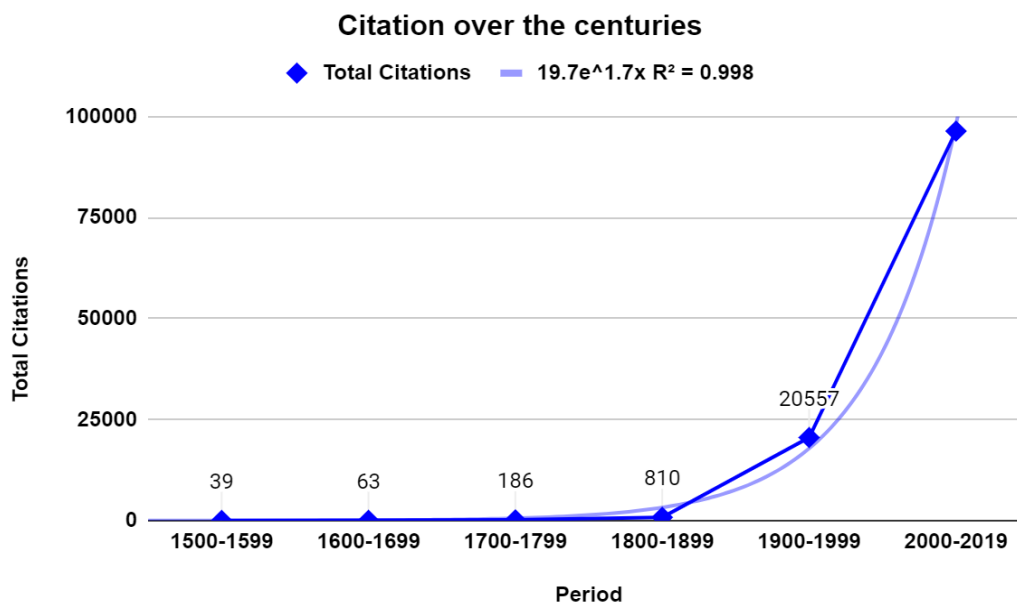


Fig.1: Trendline of the total citations of 5 centuries where R-squared value of total citations is 0.998

4.9 Ranking corresponding author's countries

The information of most cited countries is a key indicator of citation impact matrices. Citation impact is measured by counting the citations. Consequently, measuring total citations per country gives an overview of the impact of the countries.

Table 9: Data table of top 10 cited countries

| Country | TC | R |
|--------------------|-----------|----------|
| USA | 860 | 1 |
| Australia | 735 | 2 |
| Canada | 644 | 3 |
| China | 358 | 4 |
| United Kingdom(UK) | 282 | 5 |
| South Africa(SA) | 262 | 6 |
| New Zealand(NZ) | 222 | 7 |
| India | 183 | 8 |
| Spain | 135 | 9 |
| Pakistan | 120 | 10 |

Table 9 portrays the insights regarding the top 10 countries that have the highest number of citations. The USA is the most cited and impactful country. The USA ranks the top position with 860 citations followed by Australia (735), Canada (644), China (358), UK (282), SA (262), NZ (222), India (183), Spain (135), and Pakistan (120). This table also reveals that 3 Asian countries take place in the top 10.

4.10 Shared coupling of articles

Bibliographic references in scholarly publications are employed by different researchers to determine relationships among documents. "Shared coupling" is the other major area in citation analysis. It was conceptualized as "bibliographic coupling" by M.M. Kessler⁸. It focuses on mapping relations between two citing articles or documents.

Table 10: Data table of shared coupling units

| Pair of articles | | SR* | R |
|--|---|------------|----------|
| AT1 | AT2 | | |
| Wild edible plants in Yesilli (Mardin-Turkey), a multicultural area(Yesil et al; 2019) | Traditional knowledge of wild edible plants in Hasankeyf (Batman Province, Turkey) (Yesil et al; 2019) | 70 | 1 |
| How institutions shape trust during collective action: A case study of forest governance on HaidaGwaii(Hotte et al; 2019) | Influences on trust during collaborative forest governance: a case study from HaidaGwaii (Hotte et al; 2019) | 36 | 2 |
| Bridging Indigenous and science-based knowledge in coastal and marine research, monitoring, and management in Canada(Alexander et al; 2019) | Bridging Indigenous and science-based knowledge in coastal-marine research, monitoring, and management in Canada: a systematic map protocol(Alexancler et al; 2019) | 35 | 3 |
| Ethnobotany of Anti-hypertensive Plants Used in Northern Pakistan(Malik et al; 2018) | Traditional plant-based medicines used to treat musculoskeletal disorders in Northern Pakistan(Malik et al; 2018) | 32 | 4 |
| Research Methods Leading to a Perception of Knowledge Loss-One Century of Plant Use Documentation Among the Chacobo in Bolivia (Bussmann et al; 2018) | Traditional knowledge hiding in plain sight - twenty-first century ethnobotany of the Chacobo in Beni, Bolivia(Zambrana et al; 2017) | 30 | 5 |
| Impact of Climate Smart Agriculture (CSA) Practices on Cotton Production and Livelihood of Farmers in Punjab, Pakistan(Imran et al; 2018) | Traditional plant-based medicines used to treat musculoskeletal disorders in Northern Pakistan(Malik et al; 2018) | 30 | 6 |
| Research protocol for the Picture Talk Project: a qualitative study on research and consent with remote Australian Aboriginal communities(Fitzpatrick et al; 2017) | The picture talk project: Aboriginal community input on consent for research(Fitzpatrick et al; 2019) | 29 | 7 |

| | | | |
|--|---|----|----|
| Ethnobiology Through Song(Llamazares; 2019) | Sing to Learn: The Role of Songs in the Transmission of Indigenous Knowledge among the Tsimane' of Bolivian Amazonia(Reyes et al;2019) | 28 | 8 |
| Water quality and health in northern Canada: stored drinking water and acute gastrointestinal illness in Labrador Inuit(Wright et al;2018) | How are perceptions associated with water consumption in Canadian Inuit? A cross-sectional survey in Rigolet, Labrador(Wright et al; 2018) | 28 | 9 |
| Traditional uses of medicinal plants used by Indigenous communities for veterinary practices at Bajaur Agency, Pakistan(Aziz et al; 2018) | Cross-Cultural Analysis of Medicinal Plants commonly used in Ethno veterinary Practices at South Waziristan Agency and Bajaur Agency, Federally Administered Tribal Areas(Aziz et al; 2018) | 28 | 10 |

**AT1- Article Title 1; *AT2: Article Title 2; and *SR: Shared References*

Table-10 shows the shared coupling of the papers. We used the COU-file to analyze the units of shared references. We listed the top 10 pairs that include article titles. For instance, the articles (AT1 and AT2) of the first row of the table have a total of 70 common references which ranked top. In other words, both the articles have the 70 common references of all their cited references. It can be said that AT1 and AT2 (1st ranked) are bibliographically coupled. The Strength of the coupling between AT1 and AT2 can be measured by their SR(s) and their strength is clearly 70. As shared coupling is static, the strength of it cannot be changed over time². It also indicates the context, publication year, and the authors of the articles. If we go to the 4th and 6th ranked AT2, we will see that the AT2 is associated with two different articles (A1) i.e. two different pairs with more than 30 SR(s).

4.11 Co-citation network

Mapping science is another key application of bibliometrics studies. It is used to map the social or intellectual aspect. It can be done using co-citation of journals, papers, and authors. Here we have given the author a co-citation map. Author co-citations are pairs of authors as the variable that indicates their “distances” from each other²⁶.

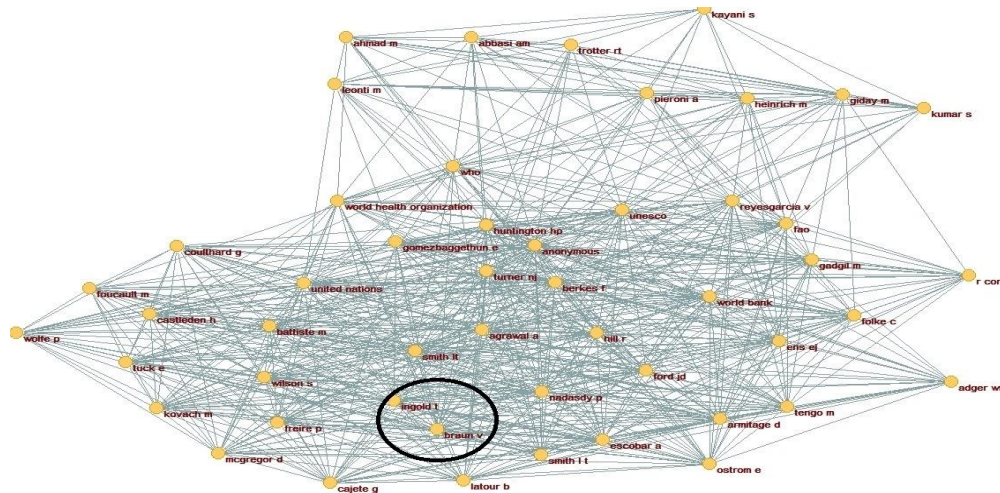


Fig.2: Cited author co-citation mapping

Figure 2 illustrates the intellectual mapping of co-citation networks of cited authors. It indicates the relationship of co-cited authors. This map is constructed Louvain clustering algorithms¹¹. Furthermore, a total of 50 nodes were selected to reduce the indistinct mapping by using Kamada and Kamai⁴ network layout. As a result, it gives clear visibility to the relationship. First, those (i.e. cited authors' publication) who are mostly cited together are closed to each other. Second, those who are co-cited in many publications are in the central part of the map. For example, Ingold, T. and Braun, V. (circled at Fig. 2) are much closed to each other, as they are cited together most. On the other hand, Anonymous authors, F. Berkes, and L.T. Smith are at the center of the map. They are co-cited together and other authors in many researches works.

5. Summary of the study

- The highly productive journals are considered as the core journals where a large portion of the researchers prefer to contribute their research work. The current study covers the scholarly publications on IK. Here, 'Journal of Ethnobiology and Ethnomedicine' has the maximum number of publications among 968 journals (see Section 4.2).
- Section 4.3 represents the author impact. B. Held ranks top by having 23 citations. The authors who Ranked 2nd to ranked 6th have been cited at least 10 times and 7th to 10th ranked authors have been cited at least 6 times.
- In Section 4.4, the information with respect to total citations of 2000 articles has been presented. A total of 683 articles yet to be cited, 20.25% articles have been cited once, 12.65 articles have been cited twice, and 3.7% articles have been cited more than 10 times.
- Section 4.5 presents the most cited journals and non-journals. 'Indian Journal of Traditional Knowledge' is the most cited (286 citations) journal and 'Decolonizing Methodologies (1999)' is the most cited (79 citations) non-journal.

- A quantitative data of highly cited authors including corporate authors (based on cited documents or references) is highlighted in Section 4.6. F. Berkes is the most cited (365) author with multiple publications and WHO is the most cited (96) corporate author.
- Section 4.7 points out the most cited documents (references) that are cited at least 30 times. L.T. Smith's monograph entitled 'Decolonizing Methodologies' is the most cited (79) document. On the other hand, among the highly cited journal articles (see Table 7), 'Rediscovery of traditional ecological knowledge as adaptive management' by F. Berkes (Published by 'Ecological Applications, 2020) is the most cited (73) journal article.
- Reference Spectroscopy shows that authors cited documents that have been published since the 16th century. Subsequently, the growth of citation has been observed in the 20th century and the peak of citation rate has been observed in 2000-2019.
- Section 4.9 deals with the list of most cited corresponding authors' countries. It indicates the USA is the most cited (860 citations) country.
- Shared coupling of documents has been analyzed in Section 4.10 which shows the foremost ranked pair has 70 SR(s). Fourth and sixth ranked AT2 are the same and associated with two different AT1(s).
- Finally, Section 4.11 illustrates the cited author co-citation network mapping. It shows the closeness of the cited authors.

6. Conclusion

Citation analysis has become a popular method in bibliometric studies. It is a systematic way to evaluate the research performance of individual authors, publishers, departments, institutions, countries, etc. in a particular subject. In this paper, we have presented different applications of citation analysis on IK scholarly works. We found the highly productive journals; the corresponding authors and their countries' impact; the highly cited references and authors; and the reference spectroscopy. We also analyzed shared coupling strengths of two articles and mapped the co-citation network to understand the relationship between two cited-authors. This paper is equally relevant and helpful to the researchers in the field of IK and LIS professionals. From the perspective of researchers of IK, they can go to the root of any sources and go through the relevant literature. As per information needs, LIS professionals also can prepare an IK reading list based on the ranking of journals, authors, and cited references.

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