A Topic Modeling-Based Bibliometric Exploration of Indigenous Knowledge Research

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Abstract

This study investigated the topics used by the Indian authors in the Indigenous knowledge research domain. A bibliometric approach is explored to identify the research done so far on the said topic by the Indian authors, collaboration pattern, and top contributing institutions. Topic modelling is used to identify the topics used by Indian authors. A relationship map is also drawn between the topics and the documents to understand the topic-wise nature of each document, and how the concepts are interrelated. A total of 821 articles contributed by Indian authors in Web of Science (WoS) indexed journals were selected for the study. The articles were analysed in terms of growth, citation rate, top-cited articles, contributing institutions, and inter-country collaboration with Indian authors. A topic modelling approach using the Latent Dirichlet Allocation (LDA) method was also used to determine the topics used by the Indian authors in the Indigenous knowledge research domain using KNIME software. Most of the topics used by the Indian authors are - plants, medicine, farming, fishing, biodiversity, species etc. A topic v/s document analysis is also done that shows the interrelationship between topic and documents. USA found to have the highest collaborative research with India in field of Indigenous knowledge research domain. The publication trend shows that many articles have been published after 2019. Implementation of National Education Policy (NEP) 2020 that encourages preservation of Indigenous knowledge might be one of the reasons that escalate the publication in this research domain.

Keywords: Indigenous Knowledge, Topic Modeling, Bibliometric, Research Trend, Traditional Knowledge

1. Introduction

Indigenous knowledge (IK) is sometimes referred to as traditional knowledge, which has been increasingly popular in recent years. However, what exactly indigenous knowledge means is not clear. Terms such as 'traditional knowledge,' 'indigenous technical knowledge,' 'indigenous knowledge,' 'local knowledge,' 'ethnoecology,' 'folk knowledge,' and 'traditional environmental knowledge or ecological knowledge' are interchangeable. While these terms have a shared meaning and can facilitate collaboration, there is a

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fundamental issue with believing that all individuals with indigenous knowledge are indigenous. Defining 'indigenous' is a complex problem with various cultural, moral, and political implications (Mistry, 2009). Indigenous knowledge is essential for survival and stability among indigenous communities, acting as an information base in local decision-making processes for agriculture, health care, food preparation, education, natural resource management, and other activities, especially in rural areas. This type of knowledge is intrinsically linked to the individuals who possess it. It is the unique, traditional, local knowledge existing within and developed around the specific conditions of people indigenous to a particular geographic region. Indigenous knowledge is the specific local knowledge found only in a certain culture or society. Indigenous knowledge can also be understood as the knowledge, inventions, and methods used by indigenous people in a variety of fields, including environmental management, agriculture, and health and medicine. Indigenous knowledge is about the ways of knowing, seeing, and thinking that are verbally transmitted from one generation to the next. It reflects thousands of years of experimentation and innovation in all aspects of life in a particular context (Kwanya & Kiplang'at, 2016). Ocholla and Onyancha (2013) describe Indigenous knowledge as "a complex set of knowledge and technologies existing and developed around specific conditions of populations and communities indigenous to a particular geographic area", emphasizing that "these forms of knowledge have hitherto been suppressed. Therefore, IKS should be brought into the mainstream of knowledge in order to establish its place within the larger body of knowledge." Additionally, they define Indigenous knowledge as a dynamic archive that contains all the information, skills, and beliefs accumulated over many generations by a community and conveyed through shared actions, objects, and sign languages. However, they draw attention to the fact that Indigenous knowledge has regrettably been disregarded, defended, stigmatized, legalized, and suppressed throughout many communities worldwide for reasons mostly related to ignorance and arrogance. Indigenous knowledge is sometimes also referred to as Indigenous Knowledge Systems and Practices (IKSP) or Indigenous Technological Knowledge (ITK). Indigenous knowledge has value not only for the culture in which it develops but also for other stakeholders. Just like any other knowledge system, the value of Indigenous knowledge increases with its application in addressing emerging challenges facing communities.

Topic modeling is used to identify the hidden theme or concept using an algorithm based on high word frequency among the documents. Latent Dirichlet Allocation is a popular topic modeling approach that identifies the most influential terms in each topic. Additionally, it offers a topic proportion to categorize all papers based on defined themes or topics. Topic modeling assigns a topic to each document, which can be used to index and link related documents in a website or database for improved search and retrieval. Topic modeling is a text mining approach that creates a generative model for documents. It uses probability distributions to organize and extract knowledge from large amounts of text data in multiple databases. This method extracts information from a document. A topic refers to the major idea discussed in a writing, encompassing multiple granularities. Topic modeling often involves into two activities: first, identify significant topics in text data and then analyze which documents cover which topic. After the implementation

of National Education Policy (NEP) 2020, Indigenous knowledge system become the matter of the moment. This article carried out with the intention to find out the overall scenario of research in the Indigenous knowledge domain by the Indian authors and the topics explored in this research domain.

2. Literature Review

Jiang et al., (2016) conducted a study of the hydropower literature worldwide, spanning from 1994 to 2013. To discover the intellectual structure, current trends, and research development of the hydropower literature, they analyzed 1726 scholarly articles that were closely related to the topic. It was found that the predominant language is English and that hydropower research articles continue to rise at a rapid pace. A total of 29 topic models were established to describe the intellectual structure of the 1726 articles and employed cluster and trend analysis to process the derived topics. Silwattananusarn & Kulkanjanapiban, (2022) investigated the evolution of information science research based on bibliometric analysis and semantic mining during the period of 2010-2020. To evaluate the development trend of information science research from statistical analysis and text mining, combined bibliometric and LDA model were developed to analyze for 42,738 articles collected from Web of Science. The considered articles were published the core journals in the field of Information Science and Library Science from 2010 to 2020. Lamba & Madhusudhan (2019) presented a method to analyze textual data and applied it to the field of Library and Information Science. Topic Modeling Toolkit was used for 393 full-text articles published in DESIDOC Journal of Library and Information Technology. Chen et al., (2020) analyzed the data collected from Web of Science indexed 3710 articles published in The British Journal of Educational Technology Journal from 1971 to 2018. It was highlighted several research hotspots and emerging topics such as Technology-enhanced classroom pedagogy, Blended learning, online social communities, Mobile assisted language learning, Game-based learning and socialized e-learning. Deshpande et al. (2023) analyzed 2198 research articles on COVID-19 vaccines indexed in MedRxiv preprint repository between January 1, 2020, and December 31, 2021. Latent Dirichlet Allocation (LDA) approach was implemented to study the preprints' thematic structure. The published articles primarily focused on clinical trials, patient responses to vaccines, and modeling for diverse applications such pathogen transmission, vaccination allocation, and vaccine reluctance. Rejeb et al. (2023) investigated the structure and dynamics of academic articles relating to Public Procurement (PP) in the period of 1984–2022. By applying bibliometric methods, it was analyzed 640 PP-related publications written by 1,247 authors and found that PP research from Scopus has been significantly increased in the past decade. Major journals publishing PP research are International Journal of Procurement Management, Journal of Cleaner Production, Journal of Purchasing and Supply Management and Public Money and Management. Cobelli & Blasi (2024) explored the Adoption of Technological Innovation (ATI) in the healthcare industry. It was investigated that how the literature has been evolved, and what are the emerging innovation dimensions in the healthcare industry adoption studies based on bibliometrics and topic modelling for 57 papers.

3. Objectives of the Study

The present study is an attempt to explore the topics of the Indigenous knowledge research domain in India as well as to map the collaboration and pattern of publication by the Indian authors on Indigenous knowledge. Based on that the following objectives are drawn for the study-

- To study the research output contributed by Indian authors on Indigenous knowledge research domain.
- To identify the top cited articles by Indian authors.
- To study the inter-country collaboration pattern and top contributed institutions among the Indian authors.
- To identify the topic used in the Indigenous knowledge research domain through topic modeling.
- To study the relationship between the documents and the assigned topics of LDA modeling.

4. Research Methodology

The sample data for this study is gathered from WoS (Web of Science) database using the search term –

(Indigenous) AND (Knowledge) (Topic) AND INDIA (Countries/Regions) AND Article (Document Types) AND 2024 (Exclude – Publication Years).

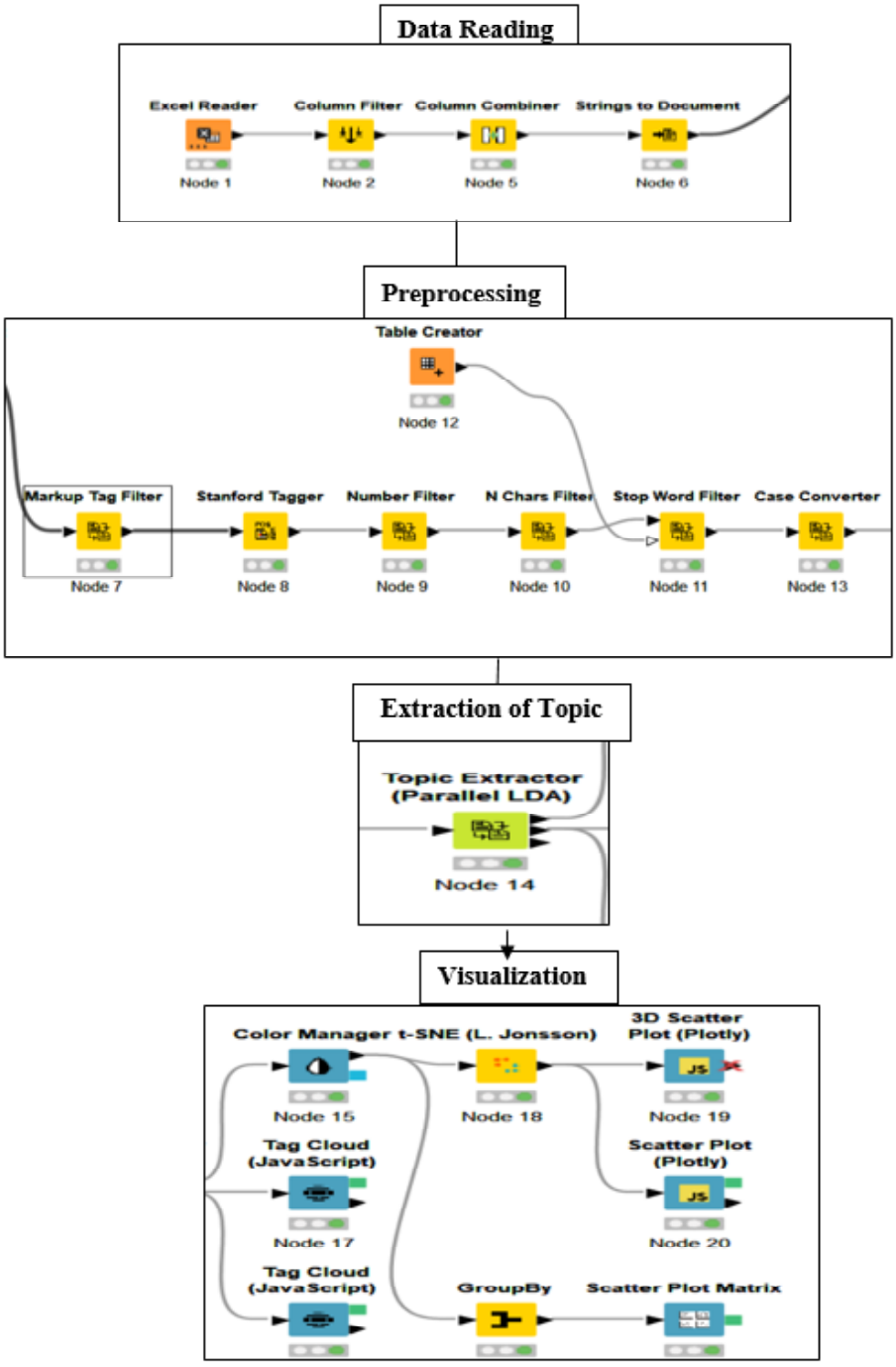

Figure - 1: KNIME Workflow

A total of 821 articles were retrieved in .txt and excel format on April 15, 2024, and VOSviewer software has been used for bibliometric analysis and visualization. KNIME software has been used for the topic modelling on collected articles. The topic modelling is performed on title and abstract of considered articles using LDA technique. Generally, LDA technique is a modelling technique that discovers the latent topics and themes from the text corpus based on the selected domain for unstructured data. The steps involved in the processing of documents in KNIME software have been depicted in the figure - 1.

5. Data Analysis and Findings

5.1 Research output

A total of 15,158 citations were received for 821 articles contributed by the Indian authors on Indigenous knowledge research domain. Out of 15,158 citations, 716 article received at least one citation, whereas 105 articles did not receive any citation. The ratio of cited article to non-cited article is 6.82:1, which means out of total 7 articles contributed by Indian authors on Indigenous knowledge research domain, one article remain uncited.

Table 1: Research output on Indigenous knowledge

Total Articles	Total Citations	Articles with minimum one citation	Articles without any citation	Cited to non-cited ratio
821	15,158	716	105	6.82:1

Figure 2 depicts the year wise published documents on Indigenous knowledge and the citations received by articles. From the graphical representation of the data, it can be clearly seen that highest number of publications is observed from the year 2020 onwards. Since the implementation of National Education Policy (NEP), 2020 in India draws attention to the dissemination, preservation, and research in traditional knowledge system which escalates the research output in this topic.

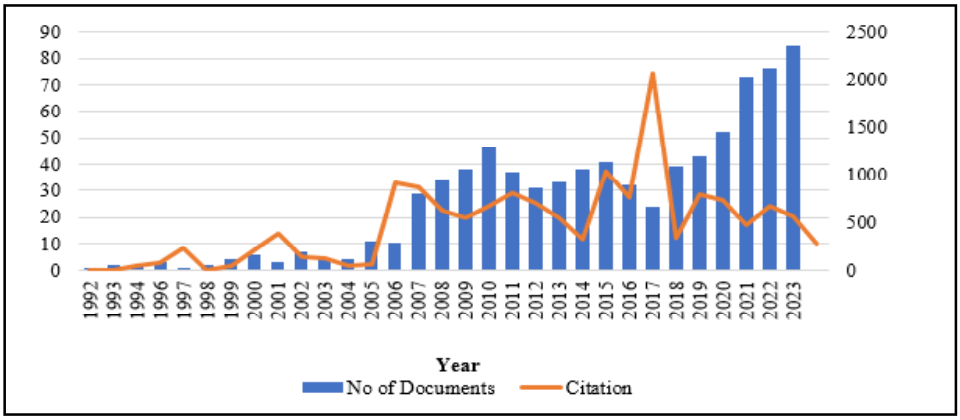

Figure 2: Year wise Documents and citation

5.2 Top cited articles on Indigenous Research Knowledge domain

The top 10 most influential articles are given in Table 2. A article entitled "The IPBES Conceptual Framework - Connecting Nature and People" is the most cited article with 1,425 citations in field of Indigenous knowledge research domain. It is published in Current Opinion in Environmental Sustainability Journal.

Table 2: Top 10 most cited articles on Indigenous Knowledge

Article Title	Source Title	Publication Year	Times Cited
The IPBES Conceptual Framework - Connecting Nature and People	Current Opinion in Environmental Sustainability	2015	1425
Indigenous Knowledge for Biodiversity Conservation	Ambio	1993	723
Medicinal Plants Used by Traditional Healers in Kancheepuram District of Tamil Nadu, India	Journal Of Ethnobiology and Ethnomedicine	2006	347
Green Purchasing Behaviour: A Conceptual Framework and Empirical Investigation of Indian Consumers	Journal Of Retailing and Consumer Services	2018	349
Psychological Science in Cultural Context	American Psychologist	1996	202
Developing The Medicinal Plants Sector in Northern India: Challenges and Opportunities	Journal Of Ethnobiology and Ethnomedicine	2006	192
A Comparison of Selected Classification Algorithms for Mapping Bamboo Patches in Lower Gangetic Plains Using Very High-Resolution Worldview 2 Imagery	International Journal of Applied Earth Observation and Geoinformation	2014	173
Ethnobotanical Survey of Medicinal Plants Commonly Used by Kani Tribals in Tirunelveli Hills of Western Ghats, India	Journal of Ethnopharmacology	2011	156
Soil Fertility and Indigenous Nutrient Supply in Irrigated Rice Domains of Asia	Agronomy Journal	2003	124
Prioritization of Medicinal Plants on The Basis of Available Knowledge, Existing Practices and Use Value Status in Uttaranchal, India	Biodiversity And Conservation	2004	112

5.3 Trends in inter-country collaboration

Table 3 represents the country wise collaboration with Indian authors in considered articles. USA was found to have the highest collaborated research with India in terms of Indigenous knowledge research

domain (47 documents) followed by England. The inter country collaboration map can be visualized from Figure 3.

Table 3: Country wise collaboration with Indian authors

Country	Documents	Citations
India	821	15158
USA	47	624
England	28	542
Canada	21	1070
Saudi Arabia	20	220
Australia	19	196
Italy	13	286
Germany	12	97
Pakistan	12	132
Peoples R China	12	256
Ethiopia	10	480
Japan	10	114
South Africa	8	106
Spain	8	154
Georgia	7	43
Switzerland	7	95
Brazil	5	99
Philippines	5	237
Scotland	5	83

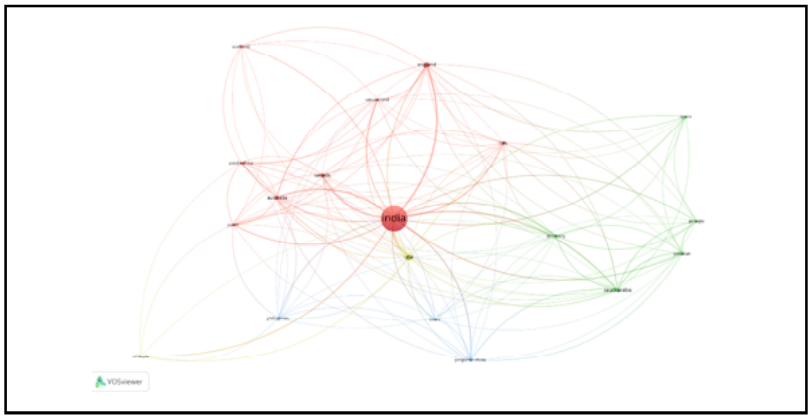

Fig 3: Inter-country Collaboration

5.4 Top Contributing Institution

Table 4 represents the top collaborated institutions in terms of documents in the indigenous knowledge research domain in India. Central Agricultural University tops the list with 35 documents. In terms of citation GB Pant National Institute of Himalayan Environment receives the highest citation.

Table 4: Top contributing Institutions

Sl. No	Organization/Institution	Documents	Citations
1	Central Agricultural University	35	325
2	GB Pant National Institute of Himalayan Environment	24	689
3	Delhi University	23	592
4	Banaras Hindu University	17	192
5	HNB Garhwal University	17	353
6	Gauhati University	16	209
7	Indian Institute of Technology System	14	200
8	Assam University	13	138
9	CSIR National Dairy Research Institution	13	82
10	Jawaharlal Nehru University	12	165

5.5 Topic wise term

For topic modeling using the LDA techniques, the values of á which depicts the document-topic density and â depicts the topic word density. With a high á value the documents are made up of more topics, while with higher â value the topics that represents the text corpus contains most of the words in text corpus. The study intends to classify the documents in terms of topics, hence choose higher value of á (0.1) than â (0.01). A total of 10 topics have been chosen to depict the topics used in indigenous knowledge research domain by the Indian authors with five words from each topic that can clearly depicts the idea used in these research articles. The terms used in describing the topics are represented in table 5.

Table 5: Topic wise terms

Topic 0	Farmers, Practices, Management, Fishing, District
Topic 1	Plants, Medicinal, Species, Families, Ailments
Topic 2	Genetic, Rice, Analysis, Diversity, Species
Topic 3	Food, Conservation, Systems, Biodiversity, Local
Topic 4	Climate, Change, Adaptation, Local, Farmers
Topic 5	Research, Development, Health, Paper, Systems
Topic 6	Activity, Soil, Potential, Treatment, Extract
Topic 7	Paper, Products, People, Ethnic, Cultural
Topic 8	Reproductive, Patients, Cattle, Animals, Milk
Topic 9	Species, Plants, Wild, Genetic, Edible

Graphical representations of the terms in each of the topics are shown in figure 4. For Topic 0, documents that highlight the terms related to farming and fishing, farmer being the high weighted term used in the documents. Topic 1, documents that highlight the theme, medicinal plants, species etc. grouped together with plants being the most used terms in these documents. As depicted in figure 5, it is quite prominent that articles on indigenous knowledge mainly governs around the topic like- medicine, plants, climate, farmers, biodiversity, conservation, soil, species etc.

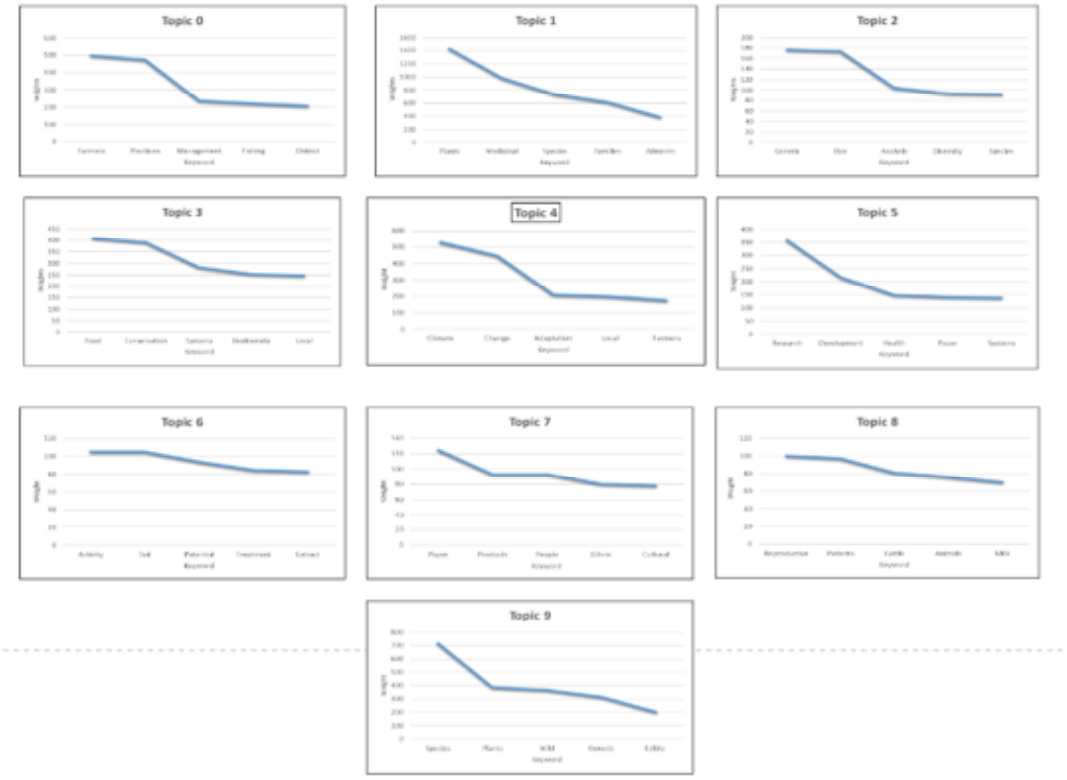

Figure 4: Weight wise topic

Figure 5: Term Map

5.6 Relationship between documents and assigned topics

SNE plot to visualize the relationship between the documents and the assigned topics of LDA is represented in figure 6. t-SNE is a statistical method that visualizes high dimensional data by depicting each data point in a two or three-dimensional map.

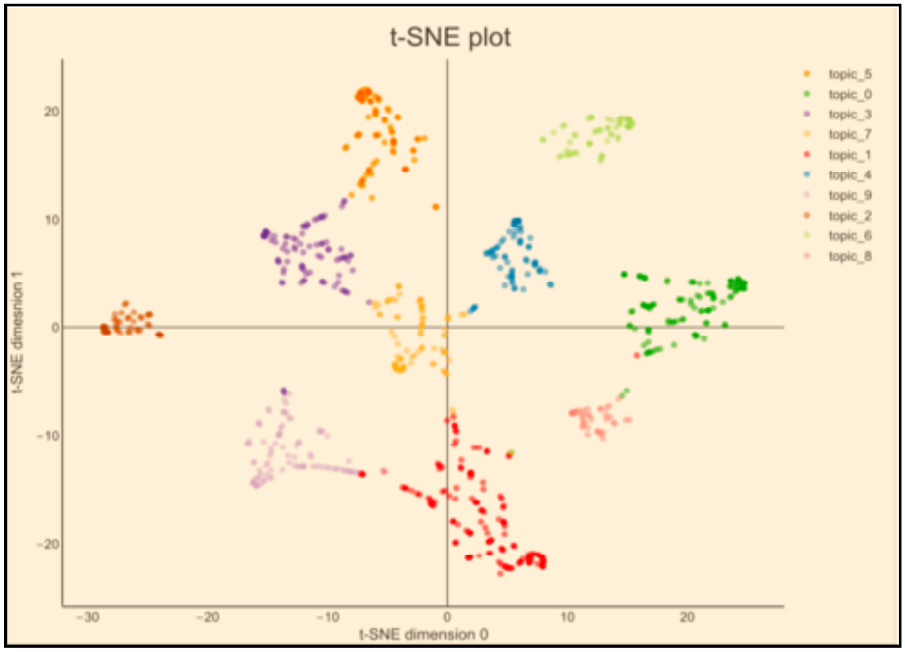

Figure 6: Document wise assigned topic

From the plot, it can be visualized that some of the documents are linked with the same topic, thus depicting the interrelationship of topics in the documents. Though the topics are unique for each cluster and for each document have unique topic assigned to it, still, there are some documents that delineate more than one topic, helping to understand the nature of each document in terms of their thought content.

6. Conclusion

Topic Modeling is generally used to understand the hidden relationship in large text corpus by assigning topics to documents. It is very helpful to understand the nature of data depicted in the documents and can be effectively used by the researcher to organize, understand, and summarize the data. The study is an attempt to understand the topic that has been used by the Indian authors in depicting the Indigenous knowledge research domain. The highly used concepts in the Indigenous knowledge research domain are: medicine, farming, fishing, climate change, biodiversity conservation, etc. These are the prominent topics in which most of the research are done by the Indian author. The USA was found to be a highly collaborated country with Indian authors in the Indigenous knowledge research domain. An in-depth study can be carried out to assess the publication pattern globally in the Indigenous research domain including different indexing and abstracting databases.

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