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COLLEGE LIBRARIES

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Contents

Web Decay Analysis and Digital Archiving of Websites of Technical Institutions: a view from Wayback Machine

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Abstract

Web Decay analysis is essential for evaluating website management and conducting regular link audits. This research is centred on evaluating the efficacy of the Wayback Machine in preserving websites belonging to Technical Institutions in the Northeastern Region of India (NEI). The specific objectives encompass comprehending archiving frequency, conducting quantitative and qualitative analyses of web links to compare features, and ranking technical institutions based on their utilisation of the Wayback machine. In this investigation, all technical institutions' websites in North East India were virtually surveyed using web browsers. A total of thirteen (13) technical institutions in the Northeastern Region of India were included in the study. The data obtained from the Wayback Machine (Internet Archive, n.d) pertain to the URLs of the technical institutions in North East India from 2013 to 2023. The analysis was performed using MS Excel 2019 and SPSS software to statistically compare the institutions' websites, revealing that the Wayback machine automatically archives all technical institution websites in NEI indiscriminately. It has proven to be a powerful tool for retrieving domain-specific information and understanding the paths to website demise. The study underscores the utility of the Wayback Machine in examining archival content, formats, and links and highlights the inconsistencies in capturing different files. It is revealed that there is a significant variation in the frequency of archiving the websites among technical institutions in NEI. The findings emphasise the need for an independent mechanism to archive websites, ensuring the retrieval of dead links for future reference.

Keywords: Digital archiving, Digital resources and services, North East India, Technical institutions, Wayback machine, Web archiving

1. Introduction

The internet's evolution and enhanced connectivity have created a global community, facilitated by mobile technologies and high-speed wireless Internet. In India, public internet access began in 1995, reaching 833 million users by July 2022. Websites play a crucial role in information delivery, necessitating streamlined design and content for user engagement. The World Wide Web, commonly referred to as the Web, serves as a vital gateway for accessing information. While exploring websites, readers often encounter what is colloquially known as a 'dead link'. These broken links occur for

various reasons, such as pointing to non-existent or inaccurate web pages. This phenomenon, termed 'Web Decay' or 'link rot', occurs when hyperlinks on individual websites or across the internet lead to permanently unavailable web pages, servers, or other resources (Kumar & Prithviraj, 2014). One prevalent cause of broken links is the disappearance of the target web page. When a previously accessible page no longer exists, users encounter a frustrating '404 error,' indicating that the web server responded but the specific content could not be found. Another type of dead link arises when the server hosting the target page ceases to function or relocates to a new domain name. Research reveals that the average lifespan of a random web page is approximately two years. When a dead web link appears within a scientific article, it carries broader implications. Fortunately, several tools are available to address these issues (Bar-Yossef, Broder, Kumar, & Tomkins, 2004). The Wayback Machine, maintained by the Internet Archive, is a crucial tool for accessing archived web content, offering a journey through digital history with over 370 billion webpages dating back to 1996.

This study focuses on the Wayback Machine's role in archiving websites of prestigious educational institutions in North East India such as Indian Institute of Technology (IIT), National Institute of Technology (NIT), Indian Institute of Management (IIM), Central Institute of Technology (CIT), Don Bosco Institute of Management (DBIM), and Manipur Institute of Technology (MIT) from 2013 to 2023.

2. Review of related literature

Several recent studies have delved into the content analysis of library websites, a well-documented area. Ramalingam (2013) found that Indian Institute of Technologies (IITs) surpassed others in its web page offerings. Pfanzelter (2020) noted that the Internet Archive's Wayback Machine remains the primary access point for obtaining historical screenshots from websites and serves as a valuable mechanism for defending intellectual property rights. Loan et al. (2023) conducted a comparative study on the efficiency of Chrome, Google, and WayBack Machine in retrieving dead links, concluding that the Wayback Machine was more efficient and effective in preserving web sources. Arora et al. (2016) highlighted challenges in scaling up the acquisition of website data from the Wayback Machine, emphasising the need for automated and manual efforts to create high-quality datasets. Additionally, Kanhabua (2016) proposed an entity-oriented search system using Bing to retrieve ranked live web results linked to the Wayback Machine, while Manohar, Banu and Punithavathani (2022) emphasised the importance of web ranking for measuring the quality and reliability of web pages.

The Internet Archive's Wayback Machine is widely utilised to estimate 'death dates' and track citations per year for Scientific Data Analysis Resources (SDAR) (Wren, et al., 2017). Studies have shown that while URL decay is a persistent phenomenon, more recognised SDARs tend to persist longer. Additionally, the Wayback Machine serves as a powerful tool for retrieving information on domain history and understanding website death paths (Kumar, 2023). It has proven beneficial in recovering vanishing online citations (Kumar, Kumar, & Prithviraj, 2015), offering researchers, authors, publishers, and editorial staff a valuable resource. Moreover, compared to search engines like Google, the Internet Archive is found to be more efficient in recovering vanished URLs (Tajedini et al., 2011). Recommendations include proactive measures to prevent citation decay and

enhance web accessibility, underscoring the importance of improved guidelines and policies for authors, editors, publishers, librarians, and web designers (Pearce & Charlton, 2009).

3. Significance of the study

In today's dynamic Information and communication technology landscape, websites of technical institutions hold immense importance. However, encountering dead links while browsing is common, often due to the disappearance of target web pages. The Wayback Machine emerges as a crucial tool to address such challenges, offering invaluable assistance to researchers, librarians, and those interested in the evolution of the web. This study focuses on analysing the role of the Wayback Machine in archiving the websites of thirteen (13) technical institutions in the north-eastern region of India, recognising the necessity to understand the archival process amidst the continuous evolution of URLs and website contents.

4. Objectives

The main objectives of the study are:

i. to outline a general overview of the technical institution's webpage

ii. to study the application of the Wayback Machine in the websites of different institutions in NEI

iii. to understand the frequency of archiving the website of the technical institution in NE India

iv. to compare the features of the archiving of the websites of the technical institutions in NEI during 2013 to 2023

v. to evaluate the quantity and quality of web links archived in the selected technical institutions

vi. to rank the technical institution in NEI with respect to the usage of Wayback Machine in solving the problem of dead links

vii. to make suggestions for improving the libraries' webpages/websites.

5. Scope and methodology of the study

The present study includes the web decay analysis and digital archiving of the websites of thirteen (13) technical institutions of North East India. They are National Institute of Technologies (NITs) in north-eastern India, Indian Institute of Technology (IIT) Guwahati, Indian Institute of Management Shillong(IIMS), Central Institute of Technology Kokhrajhar (CITK), Manipur Technical University (MTU) Manipur, and Don Bosco Institute of Management Guwahati (DBIMG). Out of these, ten (10) are Institutes of National Importance, and three (3) are All India Council for Technical Education (AICTE)-approved institutions. The websites of all the technical institutions of North East India have been surveyed virtually using Microsoft Edge web browser under Microsoft Windows 11 operating system. The data used for the study are also taken through the Wayback Machine (Internet Archive) concerning the URLs of the technical institution in North East India under study. In this regard, the data collected during 2013 - 2023 is analysed using MS Excel 2019 and SPSS software for statistical comparison of the Institution's websites.

6. Analysis of data and interpretation

The data analysis and interpretation of the study is discussed in the following sections.

6.1 *Technical institutions under study*

Table 1: Technical institutions under study **N = 13**

General Information of the Institutions				
Name of the institution	**State**	**Year of establishment**	**Ownership**	**Name of the library**
NITAP	Arunachal Pradesh	2010	Central	Central Library
NITSIL	Assam	2002	Central	Central Library
CITK	Assam	2006	Central	Central Library
IITG	Assam	(1994)	Central	Lakshminath Bezbaroa Central Library
DBIMG	Assam	2009	Private	Julhash Ali Library
NITMA	Manipur	2010	Central	Central Library
MTU	Manipur	2016	State	Manipur Technical University Library
NITM	Meghalaya	2010	Central	Central Library
IIMS	Meghalaya	2007	Central	Knowledge Centre
NITMZ	Mizoram	2009	Central	Central Library
NITN	Nagaland	2010	Central	Central Library
NITS	Sikkim	2011	Central	Knowledge and Information Centre
NITA	Tripura	2006	Central	Knowledge Centre

(Source: Websites of the technical institutions under study.)

Note: NITAP (NIT Arunachal Pradesh) NITSIL (NIT Silchar), NITMA (NIT Manipur), NITM (NIT Meghalaya), NITMZ (NIT Mizoram), NITN (NIT Nagaland), NITS (NIT Sikkim), NITA (NIT Agartala).

Table 1 summarises key aspects of the technical institutions in North East India under examination. The table shows a range of establishment years, with IITG being among the oldest (established in 1994) and MTU being the most recent (established in 2016). Assam hosts the highest number of institutions (four), followed by Manipur and Meghalaya, each with two. Other states such as Arunachal Pradesh, Mizoram, Nagaland, Sikkim, and Tripura have one NIT each. Ownership-wise, the majority of the institutions (11 out of 13) are centrally sponsored, with one state-owned and one private institution. Interestingly, seven institutions consider their library as the central library, while others have distinct names for their libraries. The Wayback Machine search indicates automatic archiving of all technical institution websites.

6.2 *Frequency of archiving*

Table 2 displays the count of web captures by the Wayback Machine of technical institutions (TI) of North East India (NEI) under distinct domain names. The present analysis reveals that a total of about 16,519 items from the websites were saved by all the technical institutions during the period from 2013 to 2023.

Table 2: Frequency of archiving the websites of the technical institutions of NEI N=13

Year	Institute Name	URL of the Institution	No. of Times Saved the Web	No. of Web Capturing
2013 -23	NITAP	https://www.nitap.ac.in/	351	7028
2013 - 23	NITSIL	https://www.nits.ac.in/	598	41278
2013 - 23	CITK	https://www.cit.ac.in/	1907	17934
2013 - 23	IITG	https://www.iitg.ac.in/	4781	313095
2013 - 23	DBIMG	https://dbim.ac.in/	146	1427
2013 - 23	NITMA	https://www.nitmanipur.ac.in/	1645	19317
2013 - 23	MTU	http://mtu.ac.in/	1212	15973
2013 - 23	NITM	https://www.nitm.ac.in/	469	12123
2016 - 23	IIMS	https://www.iimshillong.ac.in/	2284	20893
2013 - 23	NITMZ	https://www.nitmz.ac.in/	623	14860
2013 - 23	NITN	https://www.nitnagaland.ac.in/	501	11201
2013 - 23	NITS	https://nitsikkim.ac.in/	913	14779
2013 - 23	NITA	https://www.nita.ac.in/	480	12670
		Total	16519	567658

(Source: Websites of the technical institutions under study and Wayback Machine)

It is found that IITG scored the highest in capturing the webpage with 3,13,095 times, followed by NITSIL (41,278), IIMS (20,893), NITMA (19,317), CITK (17,934), MTU (15,973), NITMZ (14,860), NITS (14,779), NITA (12,670), NITM (12,123), NITN (11,201), NITAP (7,028), and DBIMG the least at 1,427 score, under a unique domain name from 2013 to 2023. Wayback Machine effectively retrieved dead path URLs for all institutions, demonstrating its effectiveness in capturing web data for NEI's technical institutions.

6.3 *Frequency of web capturing in technical institution*

Table 3 and figure 1 present the duration (in days) of the current websites of the technical institutions as captured by the Wayback Machine from 2013 to 2023.

Table 3: Number of day's web capturing during 2013 - 2023 **N=13**

Year	NITAP	NITSIL	CITK	IITG	DBIMG	NITMA	MTU	NITM	IIMS	NITMZ	NITN	NITS	NITA
2013	-	21	3	27	2	3	60	5	-	11	14	15	3
2014	2	27	7	24	6	10	19	8	-	20	14	19	8
2015	2	41	11	41	6	13	11	8	-	18	13	16	10
2016	6	78	40	60	13	36	4	25	32	48	25	30	27
2017	17	91	56	85	27	66	28	37	226	75	42	51	43
2018	6	126	48	126	34	69	21	16	211	69	18	70	34
2019	9	103	31	190	23	52	29	20	23	52	21	49	27
2020	6	35	72	358	7	24	17	21	16	18	16	23	21
2021	8	28	75	358	9	14	14	26	23	20	22	26	29
2022	14	21	302	352	11	296	297	39	32	26	21	24	33
2023	140	25	285	313	3	283	214	151	142	143	145	145	41
Total	210	596	930	1934	141	866	714	356	705	500	351	468	276
Average	19	54	84	175	12	78	64	32	64	45	31	42	25

(Source: Wayback Machine)

Some of the technical institutions like IIT Guwahati, CIT Kokrajhar, NIT, and Manipur consistently archived their institution's websites during the study. It is observed that there was a significant increase in the year 2022 and 2023. The duration of web capturing of the remaining technical institutions in NEI is highlighted in table 3. The present analysis reveals a lack of uniformity in Wayback machine archiving for all the technical institutions in NEI, except for IIMG.

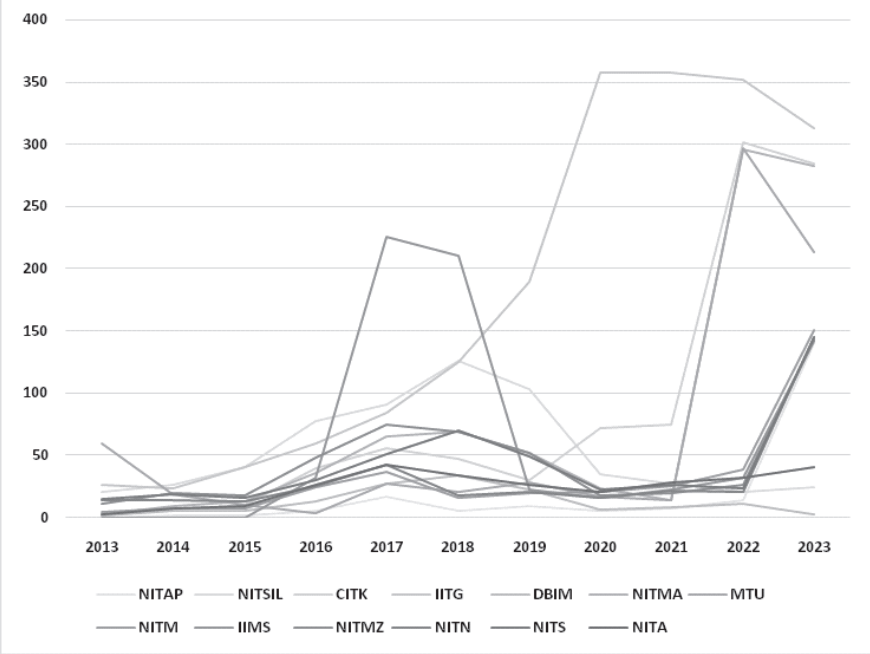

Figure 1: Trend in capturing website

6.4. *Frequency of capturing URLs in the website of technical institutions in NEI*

Table 4: Number of URLs captured in the websites of the technical institutions in NEI

Year	NITAP	NITSIL	CITK	IITG	DBIM	NITMA	MTU	NITM	IIMS	NITMZ	NITN	NITS	NITA
2013	-	773	150	4208	22	184	1582	166	-	121	106	103	2
2014	12	1290	154	6371	19	368	844	264	-	249	192	278	367
2015	67	1112	426	5725	20	185	19	24	-	464	128	403	402
2016	361	1195	225	4122	6	642	1	-	112	584	235	559	292
2017	459	1362	720	6487	54	853	389	2	104	742	955	903	644
2018	483	1597	225	11073	59	621	393	115	87	765	230	391	1091
2019	278	2194	414	12512	-	478	734	335	306	418	121	728	387
2020	4	1237	540	10512	34	761	538	641	1156	229	30	297	301
2021	237	1973	791	11837	37	936	577	875	2098	596	619	847	918
2022	445	1717	1084	19560	212	2393	2696	2999	2639	1219	1027	428	670
2023	1520	750	322	5134	39	463	486	1156	1186	225	735	238	291
Total	3866	15200	5051	97541	502	7884	8259	6577	7688	5612	4378	5175	5365
Average	351	1381	459	8867	45	716	750	597	698	510	398	470	487

Single factor ANOVA						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Institution	710919410.4	12	59243284.2	29.7159611	1.44757E-31	1.827349397
Within Institution	259174755.3	130	1993651.964			
Total	970094165.7	142				

It is observed from table 4 that there is a variation in capturing URLs (links) by the different technical institutions of NEI. Only a few institutions, like IIT Guwahati, NIT Silchar, Manipur Technical University (MTU), and NIT Manipur, have the maximum frequency of capturing URL links. The study revealed an uneven trend in capturing links in the websites of technical institutions in NEI from 2013 to 2023. By using the single factor ANOVA test, the present analysis also revealed that the F value of 29.71 is greater than the F critical value of 1.82, which means that the test is significant. The p-value of 1.44 is greater than the 0.05 significance level with 12 degrees of freedom. It shows a significant difference in the URLs captured in different technical institutions under study at a 0.05 significance level.

6.5 *Type of media captured and its frequency of capturing.*

The media file format and Media Type (MT) are categorised as Txt (Text), Img (Image), App (Application), Font, and AV (Audio and Video). The Wayback Machine archives the websites of technical institutions multiple times between 2013 and 2023, capturing both the media files and original URLs of these websites. Within the Wayback Machine, there are two types of URLs: "URLs" and "New URLs." During the archival process, "New URLs" represent the most recent links captured during the specified time frame, while "URLs" refer to previously saved links from before the designated period. Table 5 has highlighted an overview of the types of media captured in the websites of technical institutions in NEI from 2013 to 2023. Txt is predominantly captured in all technical institution websites except IIMS and NIT Arunachal Pradesh. Moreover, IIT, Guwahati is the only technical institution that scores maximum in capturing all types of media file formats (about 345491). NIT, Silchar and MTU follow it. IIMS, Shillong is the second highest in capturing the image file format. However, it is observed that the fonts and audio-visual file formats are not captured in almost all the technical institutions.

Table 5: Number of different file formats captured in the website of the technical institutions in NEI N=13

MT	NITAP	NITSIL	CITK	IITG	DBIM	NITMA	MTU	NITM	IIMS	NITMZ	NITN	NITS	NITA
Txt	1705	24353	11928	254130	1515	8805	11712	5311	6207	7058	6847	9934	7848
Img	3410	6914	2920	62547	211	3231	5040	2439	10900	2870	1220	1780	3011
App	1502	16463	2997	28751	292	7120	5726	3733	3699	5063	2977	3170	1798
Font	156	0	0	21	1	0	0	246	0	0	307	18	0
AV	0	5	9	138	0	0	0	2	87	0	0	0	0
Total	6773	47735	17854	345491	2019	19156	22478	11731	20893	14991	11351	14902	12657
Avg	615	4339	1623	31408	183	1741	2043	1066	1899	1362	1031	1354	1150

(Source: Wayback Machine)

Table 6: Ranking of technical institutions' websites based on the average number of capturing by Wayback Machine during 2013 - 2023

Capturing Websites	NITAP	NITSIL	CITK	IITG	DBIM	NITMA	MTU	NITM	IIMS	NITMZ	NITN	NITS	NITA
Average no of Days in a Year (Score out of 100)	19 (2.6)	54 (7.4)	84 (11.5)	175 (24.1)	12 (1.6)	78 (10.7)	64 (8.8)	32 (6.2)	64 (8.8)	45 (6.2)	31 (4.2)	42 (5.7)	25 (3.4)
Average number of Links Captured in a Year (Score out of 100)	644 (2.2)	2533 (8.7)	841 (2.9)	16256 (56.3)	83 (0.2)	1314 (4.5)	1376 (4.7)	1096 (3.7)	1281 (4.4)	935 (3.2)	729 (2.5)	862 (2.9)	894 (3.0)
Average number of File Formats in a Year (Score out of 100)	615 (1.2)	4339 (8.7)	1623 (3.2)	31408 (63)	183 (0.3)	1741 (4.1)	2043 (2.1)	1066 (2.1)	1899 (3.8)	1362 (2.7)	1031 (2.0)	1354 (2.7)	1150 (2.3)
Total Score (out of 300)	6	24.9	17.7	143.5	2.3	18.8	17.6	10.3	17	12.1	8.8	11.4	8.8

6.6 *Ranking based on the number of archived links*

Table 6 displays the website ranking based on the number of archived links in the Wayback Machine. The ranking of technical institutions by content capture reveals IITG at the top (with 143.5), followed by NITSIL (with 24.9), NITMA (with 18.8), and others in descending order. The analysis underscores that the Wayback Machine is a potent tool for addressing web decay in various North East India (NEI) technical institutions.

7. Discussion

The findings of the study shed light on various aspects of web archiving and the digital footprint of technical institutions in Northeast India. Notably, the establishment years of these institutions, ranging from IIT Guwahati (1994) to Manipur Technical University (2016), illustrate the evolution of technical education in the region over time. The disparity in web capturing frequency and duration among institutions, exemplified by IIT Guwahati's high capturing frequency compared to DBIMG's significantly lower one, underscores the varied approaches to web presence maintenance. Additionally, the uneven trend in capturing links highlights the complexity of web content management across institutions, supported by the significant differences in URL capturing revealed by the ANOVA test. Furthermore, the study's insight into the diversity of website content and structure underscores the need for tailored archiving strategies. While IIT Guwahati emerges as a leader in web archiving, the ranking system demonstrates variations in institutions' digital preservation efforts, emphasising the need for standardized practices and increased awareness regarding web archiving's importance in preserving institutional history and digital heritage.

8. Recommendations

In light of the challenges faced by libraries and information centres in the digital era, the study strongly recommends the integration of all intellectual content, information, and knowledge sources into local Institutional Digital Repositories (IDRs) within the respective institutions. This approach reduces dependency on parent websites and ensures the preservation of valuable resources. The study emphasises the need for a distinct archiving procedure for library websites, separate from the main institutional webpage, to enhance maintenance and recovery efforts. Furthermore, the Wayback Machine is identified as a powerful tool for retrieving archival information and understanding inactive paths within institutional websites. However, the study underscores the lack of uniformity and significant variations in web capturing methodologies and file formats among institutions, recommending each institution adopt customised archiving mechanisms to address dead links and preserve historical content effectively.

9. Conclusion

In conclusion, while issues surrounding broken links and web decay have not received as much scrutiny as other web-related topics, their significance is growing. Webmasters can mitigate these issues by conducting regular audits and crafting content to withstand obsolescence. This study sheds light on web archiving practices in technical institutions of Northeast India over a decade, utilising the Wayback Machine for analysis. The findings highlight an increase in web capturing duration, improving website management. This study aims to inform the scientific community, identify research gaps, and guide future endeavours. It is expected to assist policymakers in managing digital resources effectively and promoting standardisation, contributing to ongoing webometric research trends and shaping future agendas.

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Towards Sustainable Knowledge: integrating open access principles with green library initiatives

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Abstract

In an era marked by environmental concerns and the quest for knowledge accessibility, the convergence of Open Access (OA) principles and Green Library Initiatives (GLIs) presents a promising avenue for advancing sustainability in scholarly communication. This study explores the intersection of these two paradigms, examining their potential synergies and implications for creating a more environmentally conscious and inclusive knowledge ecosystem. By promoting unrestricted access to scholarly outputs while minimising the environmental footprint of information dissemination, this integrated approach holds the promise of fostering a more sustainable future for academia and society at large. Through a review of current literature and case studies, this paper elucidates the challenges and opportunities in aligning OA principles with GLIs, offering insights into practical strategies for libraries, publishers, and researchers to adopt sustainable practices in knowledge dissemination. Ultimately, this synthesis of OA and GLIs not only contributes to the mitigation of environmental impacts but also facilitates equitable access to knowledge, thereby fostering a more sustainable and inclusive scholarly landscape.

Keywords: Digital repositories, Green library, Knowledge sharing, Open access, Open access journals, Open educational resources, Preprint repositories, Sustainability

1. Introduction

This study is an exploration of the intersection of two critical areas in the academic and library realms: open access and sustainability. In this study, an attempt has been made to delve into the importance of adopting open access principles to promote equitable access to scholarly information while also considering the environmental impact of traditional publishing models. By merging the principles of open access with green library initiatives, innovative strategies have been proposed for libraries to not only expand access to knowledge but also minimise their ecological footprint. Through this integration, a more sustainable future has been envisioned for scholarly communication that prioritises both accessibility and environmental responsibility.

2. Literature review

Open Access, characterised by unrestricted access to scholarly research outputs, stands as a catalyst for democratising knowledge and enhancing research impact (Suber, 2012). By eliminating barriers such as paywalls, OA promotes global collaboration and innovation, aligned with sustainability principles by minimising environmental costs associated with traditional publishing models (Houghton & Sheehan, 2009). In 2022 Biswas and Das Biswas very extensively justified the potential of OA as a global performing agent and a driving force for progressive learning as

well as a roadmap to achieve sustainable development goals.

Concurrently, green library initiatives have gained momentum, focusing on reducing the environmental footprint of library operations and advocating for eco-conscious practices (Jackson & Kanellos, 2013). Strategies encompass energy-efficient building designs, waste reduction, and the adoption of digital technologies to mitigate paper consumption, thereby aligning library operations with broader sustainability objectives (Janes, 2017). It was also discussed that green libraries are planned carefully according to the green building code. To achieve this, the library building needs to be constructed with provisions for water conservation, energy efficiency (Sengupta, 2020), waste management, and a healthy indoor environment. Further more, three different methods of collecting materials and developing collections have been discussed in green libraries, namely, selecting materials that raise awareness of environmental issues, de-selection processes that emphasise the need and method for reusing and recycling materials, and selecting information sources (print or electronic) that emit less CO2.While green services are more likely to consume less paper and energy (Biswas, 2019).

The ICT must also be transformed into green information communication technology (GICT) for the library to be green. It aims to reduce carbon footprint, ICT disposal, and energy consumption as well as conserve natural resources by designing, manufacturing, using, and disposing of ICT efficiently and effectively (Biswas, 2021).

Despite the potential benefits, challenges hinder seamless integration. Financial constraints pose a significant barrier for libraries, particularly in transitioning towards OA models and implementing green infrastructure upgrades (Ouzounian & Lockwood, 2011). Concerns regarding data privacy, copyright, and digital preservation also require careful consideration when adopting new technologies and OA frameworks.

3. Significance of the study

The significance of the study lies in its potential to address pressing environmental and accessibility challenges facing libraries and knowledge institutions. By integrating open access principles with green library initiatives, this study offers a novel approach to promoting sustainability, equity, and innovation in the dissemination of knowledge. Thus, the study has the potential to drive positive change and contribute to a more sustainable and equitable knowledge ecosystem.

4. Objectives

i. To identify opportunities for integrating open access principles with green library initiatives, seeking to leverage synergies between these two approaches to promote both accessibility and environmental sustainability in scholarly communication

ii. To propose practical strategies and guidelines for libraries to integrate open access principles with green initiatives, including recommendations for promoting open access publishing, reducing paper consumption, and adopting sustainable collection development practices

iii. To advocate for the adoption of sustainable practices within the library community and raise awareness about the benefits of integrating open access principles with green initiatives among librarians, researchers, publishers, and policymakers.

5. Methodology

The methodology for this study has been designed to rigorously investigate and analyse the intersection of open access principles and green library initiatives. The following methodologies have been used for this study:

Literature review

A comprehensive review was conducted of existing literature on open access principles, green library initiatives, and the environmental impact of traditional publishing models. Key concepts, challenges, and successful case studies related to sustainability and open access in library settings were identified.

Case studies

Case studies were collected and analysed from libraries that have successfully implemented green initiatives, focusing on their strategies, challenges, and outcomes. It also explored the case studies of institutions embracing open access principles and evaluated their impact on accessibility and environmental sustainability.

Development of integration strategies

Integration strategies were also developed based on the identified opportunities and challenges, incorporating input from experts, stakeholders, and the findings from the literature review and case studies.

6. Findings and discussion

6.1 *Digitisation and digital repositories*

Green libraries can prioritise digitisation of resources to reduce the need for physical copies, thus saving paper, energy, and space. Open access materials can be hosted in digital repositories, making them freely accessible to anyone with an internet connection, thereby reducing the need for printing and shipping physical copies. Digitisation involves converting physical materials such as books, journals, and manuscripts into digital formats, reducing the need for physical copies and promoting sustainability. Digital repositories serve as centralised platforms where these digitised resources can be stored, managed, and accessed by users worldwide.

The University of California, Berkeley, Library (https://www.lib.berkeley.edu/) has launched a green library initiative to reduce its environmental impact. As part of this initiative, they aim to digitise a significant portion of their collection, reducing the demand for new physical materials and promoting sustainability.

In alignment with the green library initiative, UC Berkeley Library also promotes open access principles by making digitised materials freely available to the public through their digital repository, the UC Berkeley Digital Library. By digitising resources and making them openly accessible, they reduce the environmental footprint associated with printing, shipping, and storing physical copies while enhancing global access to knowledge.

A rare manuscript housed in UC Berkeley's collection, previously accessible only to a limited number of onsite visitors, is digitised and made available online through the library's digital repository. Researchers, scholars, and enthusiasts worldwide can now access the manuscript digitally, eliminating the need for travel to the library and reducing carbon emissions associated with transportation.

By integrating open access principles with the green library initiative through digitisation and digital repositories, UC Berkeley Library not only reduces its environmental footprint but also enhances the accessibility and impact of its collections. Researchers and students from around the

world can now engage with rare and valuable materials without relying on physical copies, contributing to a more sustainable and equitable knowledge ecosystem.

The Indian Institute of Technology (IIT) libraries have also digitised rare books and manuscripts, making them available online through their digital repositories. The Indian Institute of Science (IISc) Digital Repository also hosts a vast collection of research publications, theses, and dissertations in digital format. By providing open access to scholarly works online, IISc promotes sustainable knowledge dissemination while minimising the environmental footprint associated with traditional print collections. On the other hand, central repositories of CSIR, ICAR and DST-DBT are providing a good number of scholarly contents in OA mode which plays a crucial in the scholarly communication process in a sustainable way (Biswas, A., 2023; Biswas, A., 2023).

6.2 *Promotion of open access journals and publications*

Green libraries can advocate for and support the publication of research in open access journals. By doing so, they reduce the environmental impact associated with traditional publishing processes, such as printing, distribution, and disposal of unsold copies. This also enhances the accessibility of scholarly works, benefiting researchers worldwide.

Open access eliminates the need for printing and shipping physical copies of journals and publications. By making research freely accessible online, it significantly reduces the environmental footprint associated with traditional publishing methods. Libraries can actively promote open access platforms and repositories to encourage scholars to publish their work in environmentally friendly formats.

The Directory of Open Access Journals (DOAJ) is a community-curated online directory that indexes and provides access to high-quality, open access, peer-reviewed journals. Libraries can advocate for researchers to publish their work in journals listed on the DOAJ, thus supporting sustainable knowledge dissemination.

Open access publications are often archived in digital repositories, ensuring long-term accessibility and preservation of scholarly knowledge. This digital preservation eliminates the need for physical storage space and reduces the environmental impact associated with maintaining print collections.

The Digital Public Library of America (DPLA) (https://dp.la/) is an example of a digital repository that aggregates digital collections from libraries, archives, and museums across the United States. Libraries can contribute to and promote the use of digital repositories like DPLA to preserve and provide open access to scholarly publications sustainably.

Indian libraries are also supporting open access journals and publications to make research freely available to the public. This reduces the environmental impact associated with traditional publishing processes and enhances accessibility. For instance, the Indian Council of Agricultural Research (ICAR) encourages researchers to publish their findings in open access journals, promoting green access to agricultural research (Biswas & Das Biswas, 2023; Biswas, 2024).

The preprint repositories like AgEcon Search, arXiv, bioRxiv, ChemRxiv, ECONSTOR, ERIC, MedRxiv, OSF preprints, Zenodoetcarethe widely used platform for sharing research in agricukture, physics, mathematics, computer science, medicine and other fields. By providing open

access to preprints, the repositories promote sustainable research practices by accelerating the dissemination of scholarly knowledge and fostering collaboration among researchers worldwide (Das Biswas, & Biswas, 2023).

6.3 *Open Educational Resources (OER)*

Green libraries can curate and promote OER, which are educational materials openly licensed for free use, adaptation, and distribution. By embracing OER, libraries can reduce the demand for new textbooks, which often involve the consumption of resources like paper and ink. This promotes sustainability while making educational resources more accessible to students and educators.

The University of British Columbia (UBC) Library (https://www.library.ubc.ca/) has launched a green library initiative to reduce its environmental impact. As part of this initiative, they aim to promote the use of Open Educational Resources (OER) to reduce the demand for new textbooks and printed materials, thus lowering paper consumption and waste generation.

UBC Library collaborates with faculty members to identify existing OERs or develop new ones that align with course curricula. These resources are made freely available through the library's website or OER platforms, ensuring equitable access for students regardless of their financial resources. By integrating open access principles with the green library initiative through the adoption of OER, UBC Library reduces its environmental footprint while enhancing the affordability and accessibility of education for students. The use of OER not only eliminates the production and disposal of physical textbooks but also empowers faculty members to customise learning materials to meet the specific needs of their students, fostering a culture of innovation and collaboration in teaching and learning.

Indian libraries are promoting the use of Open Educational Resources (OER) to reduce the demand for printed textbooks and enhance access to educational materials. For example, the National Programme on Technology Enhanced Learning (NPTEL), e-PG Pathshala, Consortium for Educational Communication (CEC), Spoken Tutorial, Virtual Labs, Free and Open Source Software in Education (FOSSEE), Shodhganga, Quantum and Nano Computing Virtual Center, Open Source Courseware Animations Repository (OSCAR), E-Kalpa, Pedagogy Project and National Digital Library of India (NDLI) offers free online courses and study materials (Biswas, & Das Biswas 2023), reducing the need for printed textbooks and promoting sustainable access to education.

6.4 *Collaboration and knowledge sharing*

Green libraries can collaborate with other institutions to share resources and reduce duplication. Open access principles encourage collaboration and knowledge sharing, as researchers are more likely to share their findings when they are freely accessible. By facilitating such collaboration, libraries can reduce redundant efforts and promote more efficient use of resources.

The National Library of Scotland (NLS) (https://www.nls.uk/) has launched a green library initiative to reduce its environmental impact and promote sustainability. As part of this initiative, NLS aims to collaborate with other libraries, universities, and research institutions to share resources, expertise, and best practices for reducing energy consumption, waste generation, and carbon emissions. NLS recognises the importance of open access principles in promoting equitable access to knowledge and reducing barriers to information sharing. They advocate for open access policies and initiatives that facilitate the free exchange of scholarly research,

educational materials, and cultural resources among libraries and institutions worldwide. NLS partners with the British Library and several universities across the UK to establish a collaborative network for sharing digitised collections, research data, and scholarly publications. Through this network, libraries can collectively pool their resources to digitise rare and valuable materials, making them freely accessible to the public through open access repositories and digital platforms.

By integrating open access principles with the green library initiative through collaboration and knowledge sharing, NLS and its partners enhance the accessibility and impact of their collections while reducing their environmental footprint. Researchers, scholars, and the general public benefit from access to a wealth of digital resources, spanning diverse disciplines and historical periods, without the need for physical travel or resource-intensive printing and distribution processes.

Indian libraries are collaborating with open access advocates, academic institutions, and funding agencies to advance open access policies and practices. This includes advocating for green access initiatives and raising awareness about the benefits of open access and environmental sustainability. For example, the Confederation of Open Access Repositories (COAR) collaborates with Indian libraries to promote the adoption of open access repositories and advocate for policies that support sustainable access to scholarly research.

6.5 *Advocacy and education*

Green libraries can educate their patrons about the environmental impact of traditional publishing practices and the benefits of open access. By raising awareness and advocating for open access policies, libraries can empower researchers, educators, and students to make informed choices that support sustainability and accessibility.

The Toronto Public Library (TPL) (https://www.torontopubliclibrary.ca/) has launched a green library initiative to reduce its environmental impact and promote sustainability. As part of this initiative, TPL aims to advocate for open access policies at the local, national, and international levels and educate library users about the benefits of open access for both individuals and society as a whole. TPL hosts a series of workshops, seminars, and public lectures on the topic of open access and its relevance to libraries, education, and research. These events feature guest speakers, panel discussions, and interactive activities to engage library users and raise awareness about the importance of open access in promoting sustainability, accessibility, and innovation. By integrating open access principles with the green library initiative through advocacy and education, TPL empowers library users to become advocates for open access and sustainability in their communities. By raising awareness and providing information about open access policies and practices, TPL fosters a culture of collaboration, transparency, and knowledge sharing that benefits individuals, institutions, and society as a whole.

Libraries can also play a crucial role in promoting open access principles and raising awareness about the environmental benefits of sustainable knowledge practices through outreach programmes, workshops, and educational resources which can empower researchers, students, and the general public to embrace open access and contribute to a more sustainable knowledge ecosystem. The Scholarly Publishing and Academic Resources Coalition (SPARC) (https://sparcopen.org/) is an international alliance of academic and research libraries working to promote open access, open education, and open data. Libraries can partner with

organisations like SPARC to advocate for policies and initiatives that support sustainable knowledge practices at the institutional and global levels.

Indian libraries are providing education and training opportunities for library staff, researchers, and students on open access principles and sustainable library practices. This includes workshops, webinars, and online resources to support skill development and capacity building in areas such as copyright, licensing, and digital preservation. For example, the National Digital Library of India (NDLI) offers training programmes on digital preservation and open access publishing to librarians and researchers across the country.

The Digital Empowerment Foundation (DEF) operates community information resource centres across India, also providing access to digital resources and promoting digital literacy among marginalised communities. By fostering open access and digital inclusion, DEF contributes to sustainable knowledge dissemination and environmental conservation.

6.6 *Green infrastructure and operations*

In addition to promoting open access materials, green libraries can also adopt environmentally friendly practices in their infrastructure and operations. This can include energy-efficient lighting, sustainable building materials, waste reduction and recycling programmes, and promoting alternative transportation options for staff and patrons.

The Seattle Public Library (SPL) (https://www.spl.org/) has launched a green library initiative to minimise its environmental impact and promote sustainability. As part of this initiative, SPL renovates its main library building to incorporate green building technologies and design features, such as energy-efficient lighting, heating, and cooling systems, solar panels, and rainwater harvesting systems. They also implement waste reduction and recycling programs, promote alternative transportation options for staff and patrons, and prioritise the use of sustainable materials and practices in library operations. By integrating open access principles with the green library initiative through green infrastructure and operations, SPL reduces its environmental footprint while enhancing the accessibility and impact of its collections and services. Library users benefit from improved access to digital resources and online services, while the community as a whole benefit from reduced energy consumption, lower operating costs, and a healthier environment.

In India, some green library initiatives are Anna Centenary Library (ACL), Chennai, Karnataka University Library, Dharwad, NIT Library, Silchar, Perma Karpo Library, Ladakh (Biswas, 2019). By integrating open access principles with the concept of a green library, institutions can not only reduce their environmental footprint but also promote equitable access to knowledge and contribute to the advancement of scholarship and education on a global scale.

7. *Challenges and considerations*

It is true that green libraries can leverage open access initiatives to expand their reach and impact, providing equitable access to digital resources and services to diverse communities, including under served populations and remote regions. However, there are some challenging issues which are:

- it's essential to consider the environmental footprint of digital infrastructure, including data centres and electronic devices, and ensure renewable energy sources power them to maximise sustainability benefits

- digital divide and disparities in internet access must be addressed to ensure that open access truly enhances accessibility for all users
- issues related to intellectual property rights, licensing agreements, and author incentives may hinder collaboration and limit the potential impact of open access initiatives
- resistance from publishers, funding agencies, and other stakeholders with vested interests in traditional publishing models may pose challenges to the widespread adoption of open access policies and practices

Integrating open access principles with green library initiatives requires careful planning, investment in digital infrastructure, staff training, and ongoing maintenance to ensure the sustainability and effectiveness of digital repositories and online platforms.

Libraries must balance the desire to promote open access with the need to preserve and protect intellectual property rights, cultural heritage, and sensitive information, implementing robust policies and security measures to safeguard digital collections and user privacy.

Collaboration with stakeholders, including publishers, authors, researchers, funding agencies, and policymakers, is essential to address legal, financial, and technical challenges and develop sustainable solutions that benefit all parties involved.

8. Conclusion

The integration of OA principles with GLIs presents a compelling pathway toward sustainable knowledge ecosystems. By leveraging digital innovation and eco-conscious practices, libraries can enhance scholarly information accessibility while minimising environmental impact. Addressing financial, legal, and technological challenges is imperative to realising the full potential of this integration. Collaborative efforts among stakeholders are crucial for advancing towards a sustainable and inclusive knowledge landscape.

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Toronto Public Library (TPL) (https://www.torontopubliclibrary.ca/)

University of British Columbia (UBC) Library (https://www.library.ubc.ca/)

University of California, Berkeley, Library (https://www.lib.berkeley.edu/)

Assessing Government Polytechnic College Libraries in Darjeeling and Kalimpong Hills: a user satisfaction survey

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Abstract

The present study was conducted in two government polytechnic college libraries presented in Darjeeling hill and one in Kalimpong hill of West Bengal and it aims to give the overall picture including their establishment, staff strength, types of users, organisation and automation, collection, services and resources etc. It also aimed to analyse the users' satisfaction with the resources, services and facilities provided by the library. The survey research method using structured questionnaires was adopted for the collection of data from the library and its users. The outcome of the study will give a clear picture of the present scenario of government polytechnic college libraries in Darjeeling and Kalimpong hills and helps the library staff to know about users' viewpoints and expectations towards the library which ultimately helps to improve the services and resources of the library and also helps library staff to adopt various measures to satisfy library users in near future.

Keywords: Academic libraries, Darjeeling and Kalimpong hills, Government polytechnic College libraries, Library services and resources, Technical and vocational education, User needs, User satisfaction survey

1. Introduction

Polytechnic college is an institution of higher education offering technical and vocational education. The libraries of polytechnic colleges come under the academic library whose main objective is users' satisfaction by fulfilling their various needs. Users are the strongest pillars upon which library services rest and the success of any library depends upon the satisfaction of its users. Success hinges on efficient library management encompassing services, resources, facilities, staff, and collections (Biswas, Nausheen, & Chakrabarti, 2011), all essential for optimising user satisfaction. The polytechnic college libraries of Darjeeling and Kalimpong hills are collectively an important sector in the technical and vocational learning programme where users require effective library service in the modern information environment.

2. Review of related literature

Amidst the panoramic beauty of the Darjeeling and Kalimpong hills lies a critical component of academic advancement: the government polytechnic college libraries. These repositories of knowledge serve as the backbone of learning, yet their effectiveness in meeting user needs remains a subject of inquiry and evaluation. Biswas (2022) mentioned that the academic library is envisioned as a partner of the academic community for promoting open access,

managing content, developing new library collaborations, and supporting research. However, the role of public libraries in Darjeeling and Kalimpong cannot be overlooked. In 2023 Chakraborty, Tamang and Biswas found that the majority of library patrons of the Mirik subdivision use the resources of public libraries under Mirik subdivision to further their education. Biswas, Rai and Chakraborty (2023) also identified that users mainly visit the public libraries under block II of Kalimpong district for studying books and more than 50% of users are satisfied with the library resources and services. On the other hand, Jeeva, Balasubramani and Pratheepan (2019) investigated user satisfaction with library resources and services in polytechnic college libraries in the Coimbatore district. The result of the study revealed that library users were satisfied with most of the facilities provided by the library and also showed that user satisfaction was influenced by information resources, physical facilities and services of the library. Mani and Thirumangal (2017) highlighted the different programmes and activities conducted by the AKY Polytechnic College library to benefit the users. The result showed that 73.8% of respondents were satisfied with the overall facilities and services of the library. Mulla (2011) interpreted the user's opinion on resources, facilities and services provided by HKBK College of Engineering library. The study found that the majority 107, 82.31% of respondents visit the library to borrow textbooks and 41.54% prepare for competitive examinations. Biradar and Kumar (2000) in their study stated that, 37.5% of students and 46.88% of the teachers were satisfied with the lending service and 48.75% of students and 50% of the teachers respectively had a good opinion about the book bank facility of the DVS Polytechnic College library.

3. Statement of the problem

The preceding literature review scrutinises various articles that shed light on aspects pertaining to polytechnic college libraries and user satisfaction with their services and resources across different regions of India and abroad. However, none of these papers delve into the current state of polytechnic college libraries in the hilly areas of Darjeeling and Kalimpong in West Bengal. Therefore, this study holds significant importance as it embarks on a pioneering endeavour to evaluate the strengths and weaknesses of polytechnic college libraries in these regions. It aims to assess the services and resources offered by these libraries to meet the needs of their users and identify areas for improvement to enhance library services and user satisfaction levels.

4. Objectives

The main objectives of the study are:

i. to know the present scenario of government polytechnic college library and their services, resources and standards in Darjeeling and Kalimpong hills

ii. to know the frequency and purpose of visits to library by users

iii. to analyse the users' needs and satisfaction towards library services and resources, collections, staff and physical facilities

iv. to identify the users' obstacles while using library resources and services

v. to suggest recommendations to prevailing problems and ways and means to the improvement of library resources and services.

5. Methodology

The study is based on primary data collected through polytechnic college library

survey and user survey of Darjeeling and Kalimpong hills during the academic year 2022-23. To collect the data a pre-structured questionnaire was personally supplied among the Library In-charge/Librarian and 120 users of all three polytechnic college libraries. From there 95 filled questionnaires from library users and 3 from Library In-charge/Librarian were received back. The collected data have been tabulated, analysed and interpreted accordingly.

6. Scope and coverage

The present study covers the two government polytechnic college libraries present in Darjeeling hill and one polytechnic college library in Kalimpong hill of West Bengal and confined to the students and faculty from Civil Engineering, Science and Humanities, Mechanical Engineering, Electronic and Telecommunication, Computer Science and Technology and Electrical Engineering departments.

7. Data analysis and findings

The collected data has been analysed and reported in the following tables. Some of the findings of the study are discussed below.

Table 1: General information about library

Some general information about the three surveyed polytechnic libraries is given below:

Name of Library (Date of Survey)	Establishment Year	Address	Working Hour	Govt. /Govt. Sponsored	Contact No. /Email ID/ Website
Darjeeling Polytechnic (21.06.2023)	1964	M.V. Road, P.O. Kurseong, Dist. Darjeeeling	6hr. 30 minutes	Government	03542344434 daspoly2000@yahoo.co.in
Kalimpong Govt. Polytechnic (18/04/2023)	2019	Upper Cart Road, Gouripur, Ward No. 21, Kalimpong 734301.	8 hr.	Government	9832529051 Kalimpongpoly2018 @gmail.com
Mirik Govt. Polytechnic (24/02/2023)	2021	Nije goan, Mirik, Darjeeling – 734214.	7 hr.	Government	mirikgovtpoly@gmail.com

The above table shows that all three libraries are run by Government and working hours of these libraries vary from 6 hours to 8 hours. It was found that only Darjeeling Polytechnic library has a substantive librarian.

Physical facilities

It is found that all three polytechnic libraries do not have separate buildings and are operating in a single room without a separate reading room and with out a hall for organising programme, meetings, etc. All of them have electricity facilities but only Kalimpong Polytechnic College library has drinking water facility and a separate toilet.

Staff position

The polytechnic libraries of Darjeeling, Kalimpong and Mirik are serving with a shortage of library staff. Only Darjeeling Polytechnic library has permanent librarian with 23 years of experience and other two polytechnic colleges have no substantive librarian or permanent library staff.

Table 3: Membership statement of the library

Name of Polytechnic College Library	No. of Registered Users till date	No. of Users who Visited Library regularly
Darjeeling Govt. Polytechnic	80	20-150
Kalimpong Govt. Polytechnic	60 above	20 above
Mirik Govt. Polytechnic	49	20

Table 3 shows that Darjeeling Polytechnic has the highest number of registered users (80) and regular users who visit the library (20-150) followed by Kalimpong and Mirik.

Table 4 : Details of library collection

Name of Polytechnic College Library	Books	Journals	E-Journals	Reference materials	Newspaper and Magazines	Thesis and Dissertation	Manuscript	Govt. Publications	Others (Specify)
Darjeeling Govt. Polytechnic	10415	27	9	-	4	-	-	-	-
Kalimpong Govt. Polytechnic	1500	15	12	-	2	-	-	-	-
Mirik Govt. Polytechnic	1000	10	-	-	-	-	-	-	-

From the above table it has been discovered that most of the library collection comprises books and journals and Darjeeling Polytechnic has the highest collection followed by Kalimpong and Mirik Government Polytechnic.

Table 5 : Classification of the documents

Whether books are classified	Darjeeling Polytechnic Library	Kalimpong Polytechnic Library	Mirik Polytechnic Library
Yes	-	-	-
No	No	No	No

Table 5 shows that no polytechnic library uses any classification scheme to classify documents.

Table 6 : Catalogue code in the library

Catalogue Code Followed	Darjeeling Polytechnic Library	Kalimpong Polytechnic Library	Mirik Polytechnic Library
Yes	AACR 2	-	-
No	-	No	No

The above table shows that only Darjeeling Polytechnic library maintains and follows catalogue code AACR2 for cataloguing documents.

Table 7 : Arrangement of books on the shelves

Arrangement of the Books	Darjeeling Polytechnic Library	Kalimpong Polytechnic Library	Mirik Polytechnic Library
Subject	Yes	Yes	Yes
Author	-	Yes	-
Size	-	-	-
Call No.	-	-	-
Other	-	-	-

From the above table it is observed that all three polytechnic libraries arrange books on the shelves according to subject. Apart from the subject Kalimpong Polytechnic library arranges books according to author also.

Table 8 : Various services and resources provided by the library

Services and Resources provided by the Library	Darjeeling Polytechnic Library	Kalimpong Polytechnic Library	Mirik Polytechnic Library
Circulation	Yes	Yes	Yes
OPAC	No	No	No
Literature search and reference queries	No	No	No
Bibliography	No	No	No
CAS	No	No	No
SDI	No	No	No
Reprography	No	Yes	No
Internet/Wi-Fi connection	Yes	Yes	No
Computer	Yes	Yes	No
Library Orientation	Yes	No	No
Others	No	No	No

Table 8 shows that all three polytechnic libraries provide circulation i.e. lending and borrowing service to their users. OPAC, literature search and reference query, bibliography, CAS, SDI services are not provided by any one of them. Only Kalimpong Polytechnic library provides reprography service. Internet/Wi-Fi connection and computer facilities are provided by Darjeeling and Kalimpong Polytechnic library. Orientation programmes are organised by only Darjeeling Polytechnic library for the users.

Table 9 : Automation in the library

Automation status of the Library	Darjeeling Polytechnic Library	Kalimpong Polytechnic Library	Mirik Polytechnic Library
Fully Automated	-	-	-
Partially Automated	-	-	-
Under Process of automation	Yes	-	Yes
Not automated	-	Yes	-
Software used	E-granthalaya	-	-
Digitised any Documents	-	Journal	-

From the above table it is found that Darjeeling and Mirik Polytechnic library are under the process of automation and only Darjeeling Polytechnic library is using the software E-granthalaya. Kalimpong Polytechnic library has no instance of library automation but the library is digitising the journal.

Table 10 : Barriers to automation

Barriers to Automation	Darjeeling Polytechnic Library	Kalimpong Polytechnic Library	Mirik Polytechnic Library
ICT trained Staff	Yes	Yes	Yes
Power	Yes	No	No
Space	No	No	No
Cooperation of Authority	Yes	No	No
Finance	Yes	No	No
Others	-	-	-

From the above table it is found that the main barrier to automation is trained library staff in all three polytechnic colleges. In Darjeeling Polytechnic library power, cooperation of authority and finance also act as barriers to automation. However, in two other polytechnic libraries, there are no such barriers to automation.

Now moving on to the users' response towards the purpose of visiting library and the level of satisfaction towards library services and resources, collection, physical facilities and the problems faced by three polytechnic libraries following findings have been come out.

Table 11: Users' response to the purpose of visiting library

Purpose of visiting	Darjeeling Polytechnic Library	Kalimpong Polytechnic Library	Mirik Polytechnic Library
To borrow and return books	20(50%)	24(77.4%)	14(58.3%)
To consult books	6(15%)	8(25.8%)	5(20.8%)
To consult journals	1(2.5%)	0(0%)	4(16.7%)
To consult previous year question paper	7(17.5%)	4(12.9%)	2(8.3%)
To browse internet resources	1(2.5%)	0(0%)	1(4.2%)
To read newspaper	11(27.5%)	0(0%)	0(0%)
To do assignment	22(55.5%)	0(0%)	2(8.3%)
To prepare for examination	14(35%)	8(25.8%)	7(29.2%)
Others	0(0%)	0(0%)	0(0%)

From table 11 it is found that the main purpose of visiting the library by the maximum number of users of Darjeeling Polytechnic 20(50%), Kalimpong Polytechnic 24 (77.4%) and Mirik Polytechnic 15 (58.3%) is to borrow and return the books.

Table 12 : Users' response to the services and resources provided by the library

Services and resources provided by the library	Darjeeling Polytechnic Library			Kalimpong Polytechnic Library			Mirik Polytechnic Library		
	S	LS	NS	S	LS	NS	S	LS	NS
Circulation	36 (90%)	3 (7.5%)	1 (2.5%)	10 (32.2%)	14 (45.2%)	7 (22.6%)	14 (58.4%)	5 (20.8%)	5 (20.8%)
Library catalogue and OPAC	17 (42.5%)	20 (50%)	3 (7.5%)	5 (16.1%)	12 (38.7 %)	14 (45.2%)	7 (29.2%)	11 (45.8%)	6 (25%)
Literature search and reference queries	26 (65%)	13 (32.5%)	1 (2.5%)	7 (22.6%)	10 (32.2%)	14 (45.2%)	11 (45.8%)	7 (29.2%)	6 (25%)
Reprography	9 (22.5%)	9 (22.5%)	22 (55%)	0 (0%)	5 (16.1%)	26 (83.9%)	0 (0%)	7 (29.2%)	17 (70.8%)
Internet Access/ Wi-Fi Connection	2 (5%)	6 (15%)	32 (80%)	0 (0%)	7 (22.6%)	24 (77.4%)	4 (16.6%)	7 (29.2%)	13 (54.2%)
Library website	9 (22.5%)	20 (50%)	11 (27.5)	0 (0%)	4 (12.9%)	27 (87.1%)	4 (16.6%)	6 (25%)	14 (58.4%)
Library timing	24 (60%)	12 (30%)	4 (10%)	3 (9.7%)	11 (35.5%)	17 (54.8%)	13 (54.2%)	8 (33.3%)	3 (12.5%)
Provision of Computer/PCs	16 (40%)	12 (30%)	12 (30%)	5 (16.1%)	4 (12.9%)	22 (71%)	9 (37.5%)	7 (29.2%)	8 (33.3%)
Arrangement of books on the shelves	30 (75%)	10 (25%)	0 (0%)	21 (67.7%)	7 (22.6%)	3 (9.7%)	15 (62.5%)	7 (29.2%)	2 (8.3%)
Library orientation	25 (62.5%)	13 (32.5%)	2 (5%)	5 (16.1%)	3 (9.7%)	11 (35.5%)	17 (54.8%)	16 (66.7%)	5 (20.8%)

(S= Satisfied, LS=Less Satisfied, NS=Not Satisfied)

From the above table it is found that maximum users of Darjeeling Polytechnic are satisfied with the circulation 36 (90%), literature search and reference queries 26 (65%), library timing 24 (60%), provision of computer 16 (40%), arrangement of books 30 (75%) and library orientation 25 (62.5%)but the users of the Kalimpong Polytechnic library is only satisfied with arrangement of books on the shelves 21 (67.7%). Similarly, the majority of users of Mirik Polytechnic are satisfied with circulation14 (58.4%), literature search and reference 11 (45.8%), provision of computers 9 (37.5%), arrangement of books on the shelves 15 (62.5%) and library orientation 17 (54.8%).

Table 13 : Users' response to the collection of the library

Library Collection	Darjeeling Polytechnic Library			Kalimpong Polytechnic Library			Mirik Polytechnic Library		
	S	LS	NS	S	LS	NS	S	LS	NS
Printed books	24 (60%)	12 (30%)	4 (10%)	13 (42%)	9 (29%)	9 (29%)	10 (41.7%)	11 (45.8%)	3 (12.5%)
Printed Journals	22 (55%)	14 (35%)	4 (10%)	6 (19.3%)	12 (38.7 %)	13 (42%)	4 (16.7%)	9 (37.5%)	11 (45.8%)
Reference materials	21 (52.5%)	18 (45%)	1 (2.5%)	11 (35.5%)	11 (35.5%)	9 (29%)	10 (41.7%)	9 (37.5%)	5 (20.8%)
Syllabi and previous year question papers	19 (47.5%)	16 (40%)	5 (12.5%)	4 (13%)	4 (13%)	23 (74%)	5 (20.8%)	5 (20.8%)	14 (58.4%)
Newspaper and magazine	25 (62.5%)	14 (35%)	1 (2.5%)	1 (3.2%)	4 (13%)	26 (83.8%)	0 (0%)	7 (29.2%)	17 (70.8%)
Audio visual materials	3 (7.5%)	17 (42.5%)	20 (50)	0 (0%)	4 (12.9%)	27 (87.1%)	0 (0%)	5 (20.8%)	19 (79.2%)
E-books	3 (7.5%)	12 (30%)	15 (37.5%)	1 (3.2%)	14 (45.2%)	16 (51.6%)	2 (8.3%)	7 (29.2%)	15 (62.5%)
E-journals	3 (7.5%)	12 (30%)	15 (37.5%)	0 (0%)	12 (38.7%)	19 (61.3%)	0 (0%)	8 (33.3%)	16 (66.7%)

(S= Satisfied, LS=Less Satisfied, NS=Not Satisfied)

Table 13 represents the users' response towards the collection of the library and it is found that users of the Darjeeling Polytechnic library are satisfied with most of the collection of library except audio-visual materials 3 (7.5%), E-books 3 (7.5%), and e-journals 3 (7.5%). On the other hand, users of the Kalimpong Polytechnic library are satisfied only with printed books 13 (42%) and reference materials 11 (35.5%). However, the users of the Mirik Polytechnic library are not satisfied with the collection of the library.

Table 14: Users' response to the physical facilities of the library

Physical Facilities of the Library	Darjeeling Polytechnic Library			Kalimpong Polytechnic Library			Mirik Polytechnic Library		
	S	LS	NS	S	LS	NS	S	LS	NS
Location	29 (72.5)	9 (22.5%)	2 (5%)	25 (80.6%)	5 (16.2%)	1 (3.2%)	17 (70.8%)	6 (25%)	1 (4.2%)
Layout	31 (77.5%)	7 (17.5%)	2 (5%)	25 (80.6%)	4 (12.9 %)	2 (6.5%)	14 (58.3%)	10 (41.7%)	0 (0%)
Space	19 (47.5%)	13 (32.5%)	8 (20%)	27 (87.1%)	3 (9.7%)	1 (3.2%)	20 (83.3%)	4 (16.7%)	0 (0%)
Furniture	29 (72.5%)	10 (25%)	1 (2.5%)	27 (87.1)	3 (9.7%)	1 (3.2%)	14 (58.3%)	10 (41.7%)	0 (0%)
Lighting and ventilation	32 (80%)	7 (17.5%)	1 (2.5%)	29 (93.6%)	1 (3.2%)	1 (3.2%)	15 (62.5%)	8 (33.3%)	1 (4.2%)
Cleanliness and neatness	32 (80%)	8 (20%)	0 (0%)	22 (71%)	9 (29%)	0 (0%)	18 (75%)	5 (20.8%)	1 (4.2%)
Property Counter	23 (57.5%)	14 (35%)	3 (7.5%)	19 (61.3%)	7 (22.5%)	5 (16.2%)	7 (29.1%)	13 (54.2%)	4 (16.7%)

(S= Satisfied, LS=Less Satisfied, NS=Not Satisfied)

From the above table it is clear that the majority of the users of Darjeeling, Kalimpong and Mirik Polytechnic libraries except for property counter 7 (29.1%) in Mirik Polytechnic library are satisfied with the overall physical facilities of the library.

Table 15 : Users' response to the problems faced by them while using library resources

Problems	Darjeeling Polytechnic Library	Kalimpong Polytechnic Library	Mirik Polytechnic Library
Lack of friendly and efficient library staff	1 (2.5%)	3(9.7%)	3(12.5%)
Inadequate resources	5 (12.5%)	5(16.1%)	7(29.2%)
No internet and Wi-Fi facilities	33(82.5%)	23(74.2%)	11(45.8%)
Collection are inadequate	5(12.5%)	12(38.7%)	6(25%)
Poor organization of materials on the shelves	1(2.5%)	1(3.2%)	1(4.2%)
Insufficient number books	5(12.5%)	19(61.3%)	12(50%)
Insufficient number computers	8(20%)	7(22.6%)	5(20.8%)
Lack of space in reading room	13(32.5%)	2(6.4%)	0(0%)
Poor electronic/online services	8(20%)	12(38.7%)	5(20.8%)
Not aware of how to use library	0(0%)	1(3.2%)	1(4.2%)
Others	0(0%)	0(0%)	0(0%)

Table 15 shows that the majority of the users of Darjeeling 33(82.5%) and Kalimpong 23 (73.4%) polytechnic libraries express the lack of internet and Wi-Fi facilities in the library. On the other hand, users of the Mirik Polytechnic library faced problems due to an insufficient number of books 12 (50%) followed by a lack of internet and Wi-Fi facilities 11(45.8%) in the library.

8. Discussion

During the survey of these three polytechnic libraries, it was discerned that while the Darjeeling Polytechnic library is established, the libraries in Kalimpong and Mirik are still in their nascent stages of development. This is reflected in their limited services, resources, collections, and physical infrastructure due to their recent establishment. Across all three libraries, there is a noticeable dearth of proficient and adequately trained staff.

Furthermore, it became apparent that the primary requirements of the library users encompass new books aligned with the current syllabus, access to journals and e-journals, computers, reprography services, as well as Wi-Fi and internet connectivity within the library premises. Although users express varying degrees of contentment with the available collection and physical amenities, there remains ample room for enhancement and refinement in the future development of these three polytechnic libraries.

9. Recommendations

Major recommendations which emerged out of the study areas follows:

- Libraries should implement new and innovative technologies to help the users to get their satisfaction. It is better to install Integrated Library Management Software for smooth functioning of the library.
- College management should provide efficient and trained staff to efficiently serve the user.
- Proper classification and catalogue code should be followed to organise their collection.
- Regular feedback from the library users should be taken to know their

needs regarding library resources and services.

- As they are the only three polytechnic libraries present in the hilly region, it is recommended to do resource sharing like inter-library loan service among themselves to provide the resources needed by the users that are not available in their library.

10. Conclusion

In conclusion, the assessment of polytechnic college libraries in Darjeeling and Kalimpong hills underscores their unique significance within the emerging educational landscape of the region. As these institutions continue to evolve, it is imperative that library design integrates the latest information technologies and prioritises user needs and satisfaction. The insights gleaned from this study are poised to catalyse improvements in library services and resources, offering a substantial benefit to users across these hilly regions. Moving forward, a concerted effort to enhance these libraries will undoubtedly contribute to the enrichment of academic experiences and facilitate the pursuit of knowledge within the polytechnic college community.

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Research Trends in Odia Language and Literature : a study of Shodhganga repository

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Abstract

Electronic Thesis and Dissertations (ETD) play a vital role in the progress of research heritage. Shodhganga is the archiving of Indian doctoral theses and dissertations, it helps in raising the standard and quality of research. This paper has examined the contribution of theses and dissertations in Odia language and literature. This research has been collected from 8 universities of Odisha a total of 1,126 theses data from Shodhganaga during 1905-2023. The data carpentry tool Open Refine has been used for data refinement, universities h-index and i10 index fetched from Open Alex and the Gender API used for identification of gender scholars and supervisors. This research has found that following key results most productive university is Utkal University (contribution, 70.15%), and 1984 to 2003 is the most productive period. This study also found that the highest number of theses have been supervised by Ashutosh Pattanaik, affiliated with Utkal University. In gender ratio,91.38% of the supervisors are male, followed by 60.57% of scholars who are male.

Keywords: Doctoral theses, Electronic thesis and dissertations, Odisha, Odia language and literature, Shodhganga

1. Background

The Government of India, in its eighth schedule of the constitution, has prioritised encouraging all Indian languages and identified six classical languages. Odia was declared a classical language in 2014 and is one of the oldest languages in the country. Hence, a lot of research has been done on this language overall in India. For research purposes in any university, a thesis is a significant and vital primary source of information. Still, now only the academic community has access to these resources in the country (Mir & Sevukan, 2021). The New Education Policy of India (NEP 2020) aims to establish research-intensive universities to boost the Gross Enrolment Ratio (GER) by adjustments to practices and policies. For this, research conducted in Indian universities is made accessible through the open ETD repository Shodhganga, which is the project of INFLIBNET, Ahmedabad. It is an open-access tool for academics and researchers worldwide (Manoj Kumar & Joorel, 2022). The institutes and researchers have played a significant role in the development of the Indian higher education system (Kumar et al., 2023). ETDs rank among the most widely used and valuable open-access tools for academics and researchers worldwide. The repository can capture, index, store, disseminate and preserve ETDs submitted by the researchers. To get ETD in India there are four kinds of channels i.e. Shodhganga, NDL,

institutional repositories and OPAC of particular institutes' libraries (Kaur & Bhatt, 2022). There are 22 state universities and one central university in the state of Odisha. Of this, only seven state universities and the Central University of Odisha contributed Odia theses and dissertations in the Shodhganga. This study has analysed Odia theses and dissertations indexed in the Shodhganga by the universities of Odisha.

While going through the review of related studies, it was found that no studies on the coverage of Odia language theses in the Sodhganga. So, we are stimulated to explore the gender differential of Odia literature of only the researchers' supervisors who have submitted their doctoral dissertations in India. Shodhganga ('Shodh' means research in Hindi, and 'Ganga' is a large river in India) is a repository of doctoral theses and dissertations submitted to Indian Universities, and houses 4,57,121 (19-05-2023) theses and dissertations being contributed by 715 universities in India (Kumar et al., 2023). In this paper, we have tried to measure the gender differential ratio of PhD scholars and supervisors using Gender API. It gives a drone view and statistical touch of universities ranking in terms of h index, i10 index and contribution of theses. It also analyses the most frequently used keywords by the researcher.

2. Review of literature

Studies on Electronic theses and dissertations have been actively investigated in the last decade to better understand the academic integrity of PhD research output (Kumar et al., 2023). Some recent studies tried to measure the research outputs present in ETD and also to characterise them concerning time, discipline, university and state. Some studies focused on specific countries such as Sri Lanka and Bangaldesh (Rahman & Perera, 2022), South Africa (Bangani, 2018), Nigeria (Ezema & Ugwu, 2013), Zimbabwe (Chisita et al., 2020) and a few others on particular subjects (Gogoi, 2018; Mir & Sevukan, 2021; Hazarika & Sudhier; 2022 Suhalka, 2022). They studied different data sources.

Looking into this scenario, Kaur and Bhatt, (2022) have argued the duplication availability of ETDs, methods of searching, packaging and metadata across various channels.To gain a broader perspective on the phenomenon some scholars (Bangani, 2018; Gogoi, 2018; Rahman & Perera, 2022; Saikia & Das, 2014) have discussed the present status of ETD.

Some of the studies have disclosed connections between researchers, and supervisors in ETD, which focus on the direct academic status of universities and contribution theses and dissertations in Shodhganga. Researchers in India (Biswas, 2016; Chauhan, 2021; Esh, 2015; Jeyapragash et al., 2016; Chavan & Sawai, 2019; Esh & Ghosh, 2021; Katagi & Kumbar, 2022; Khode, 2021; Ramdas Lihitkar & Lihitkar, 2014; Roy & Ghosh, 2022) have explored availability, visibility, impact, trend derivative of year, language, university and to learn about the prominent supervisor and researchers. They have contributed significantly to the progress of their respective areas from different states. Biswas, (2016) has performed a ranking method for identifying the current problem and contribution of West Bengal's top ten universities.

Saikia and Das, (2014) have figured the comparative study of among universities of Assam in terms of the contribution of theses. Esh and Ghosh, (2021) presented India's Open DOAR status with special attention on statistical analysis using JASP software of ETD submitted to Shodhganga repository by Northeast university.

In addition, Mir and Sevukan, (2021) have focused on visibility, accessibility, and possible impact of Library and Information Science (LIS) Ph.D. theses in Shodhganga. They have analysed the contribution of theses from different states of India, the impact of e-theses on citation rate by gathering information from Google Scholar. They have found that Karisiddappa C. R., Sangam S. L. are the most productive supervisors and well-known personalities in the field of LIS in India. Gogoi, (2018) also explored a total of 548 Ph.D. theses in LIS domain of Indian Universities during the period 2013-2017. On the other hand, Suhalka, (2022) has studied Hindi literature availability in Shodhganga repository. He has viewed the contributions of central universities of India. Hazarika and Sudhier, (2022) have analysed the 445 doctoral research in Assamese language and literature uploaded in Shodhganga.

Given the above situation, there are no previous studies that analyse Odia literature submitted by universities of Odisha in Shodhganga in terms of gender differentiation of researcher and supervisor, designation, length of the theses and keyword analysis. This paper tries to bridge this gap and the present study carried out the contribution of Ph.D. research output of universities of Odisha submitted to Shodhganga.

3. Objectives

i. To analyse the year wise research growth of the Odia language in Shodhganga

ii. To find out the status of universities of Odisha submitting ETDs in Odia language

iii. To identify the MoU signed to Shodhganga in Odisha universities

iv. To examine the most productive supervisors

v. To find out gender differential of supervisors and scholars.

4. Methodology

The study was conducted by searching the theses in the Shodhganga submitted by the universities of Odisha. The data has been collected from the Shodhganga website up to April 2023. It was found that eight universities have contributed 1,151 Odia language and literature theses. Out of which, 20 are duplicates, and 5 are wrongly indexed on the website. By exuding these theses, finally, 1,126 theses were identified for the study. Metadata has been collected, classified, compared and further analysed against the objectives of the study. Data on year, research scholar, pagination, supervisors, designation and category were obtained from the metadata or title page of the theses. To identify the gender of research scholars and supervisors, this study used Gender API and the data carpentry tool Open Refine.

5. Analysis

The study aimed to examine the research trend of literature in the field of Odia submitted in the Shodhganga repository. It analyses 1,126 Odia language theses from 1905 to 2023 to find out the status and growth of the research output of the universities of Odisha.

5.1 *Contribution of theses in the Shodhganga*

Table 1: Name of the universities and their contributions in the Shodhganga over the time of 1905-2023

Sl No.	Name of the Universities	Year of Establishment	Sign MOU year	h-index	i10-Index	Contribution of Theses
1	Utkal University	1943	2016	84	863	790 (70.15%)
2	Sambalpur University	1967	2012	57	557	259 (23.00%)
3	Berhampur University	1967	2020	54	432	26 (2.30%)
4	Ravenshaw University	2006 (as a university)	2020	47	378	25 (2.22%)
5	Fakir Mohan University	1999	2020	33	154	14 (1.24%)
6	Central University of Odisha	2009	2015	18	39	10 (0.88%)
7	Gangadhar Meher University	2015 (as a university)	2021			1 (0.08%)
8	Rama Devi Women's University	2015 (as a university)	2021	19	38	1 (0.08%)
9	Total					1,126

Table 1 analyses the universities of Odisha in terms of year of establishment, h-index, i10 index, signing MoUs and contributing electronic theses to the Shodhganga repository. Open Alex has been used for retrieval of h-index and i10 index. The data highlights key metrics for each university and provides insights into their research and academic contributions. Utkal University is the earliest university in Odisha, established in 1943. Gangadhar Meher and Rama Devi Women's University both are youngest universities established in 2015. All 8 universities from Odisha signed MoU with Shodhganga and Ph.D. theses are uploaded or submitted to Shodhganga for institutional repository. Utkal University stands out with a significant h-index of 84 and i10 index of 863 indicating substantial research impact. It also has the highest contribution of theses, accounting for 790 (70.15%) of the total. Sambalpur University follows closely with an h-index of 57, an i10 index of 557 and contributes 259 (23%) of theses. 26 (2.3%) theses have been submitted by Berhampur university to stand in the third position. However, Ravenshaw University and Gangadhar Meher University have submitted only one thesis to Shodhganga. The analysis highlights the varying levels of academic impact and research output among the universities in Odisha. Utkal University emerges as a prominent institution, demonstrating substantial research contributions with a high h and i10 index. Sambalpur University also exhibits commendable research activity.

5.2 *Year wise growth of theses*

Table 2: Yearly growth of theses contributed by universities of Odisha

Name of Universities	1903-1922	1923-1943	1944-1963	1964-1983	1984-2003	2004-2023	Total
Utkal University	1	0	1	38	473	277	790
Sambalpur University	0	0	0	8	119	132	259
Berhampur University	0	0	0	0	0	26	26
Ravenshaw University	0	0	0	0	0	25	25
Fakir Mohan University	0	0	0	0	0	14	14
Central University of Odisha	0	0	0	0	0	10	10
Gangadhar Meher University	0	0	0	0	0	1	1
Rama Devi Women's University	0	0	0	0	0	1	1
Total	1	0	1	46	592	486	1,126

To understand the actual growth of these and the dissertations in Odia language we analyse the 15-year interval contribution of theses. According to year-wise contributions of theses from universities of Odisha a greater number of theses contributed 473 to Shodhganga from 1984 to 2003 from Utkal University, followed by Sambalpur University 119. Table 2 depicts year-wise information on universities of Odisha existing data in the Shodhganga.

5.3 *Language-wise distribution*

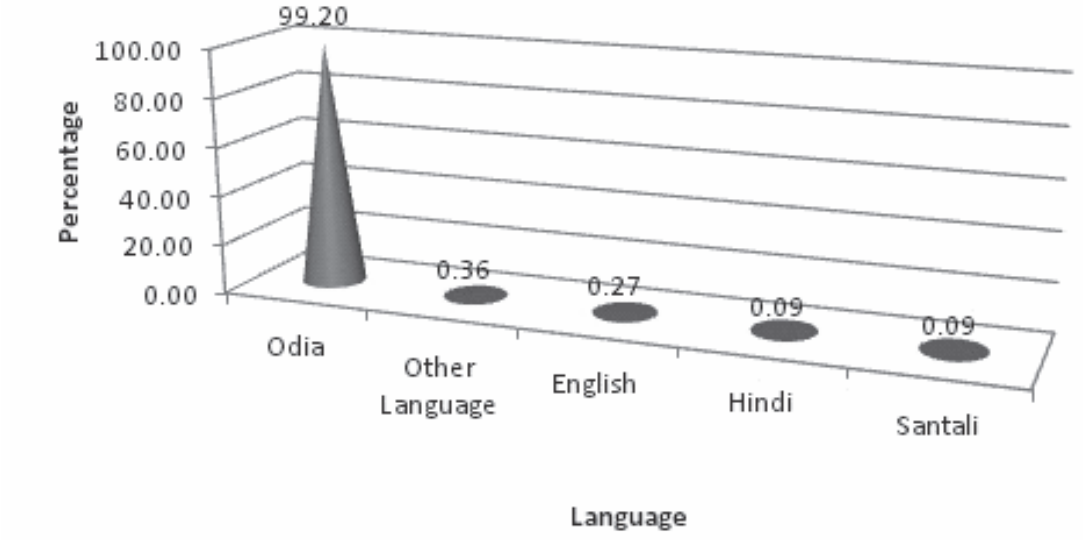

Figure1: Language-wise distribution

Figure 1 represents the language distribution of Odia theses. This study has revealed that most of the theses are in the Odia language 1,117 (99.20%) followed by 4 (0.36%) in other languages, 3(0.27%) in English and one each in Hindi and Santali languages.

5.4 *Gender-wise contribution of research scholars and supervisors*

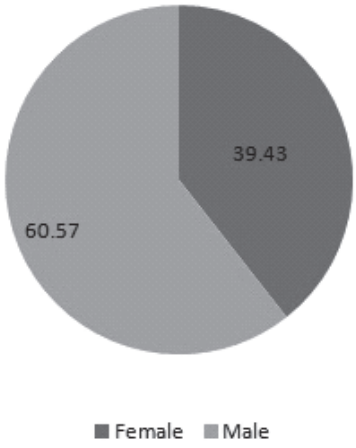

Figure 2: Gender-wise contribution of research scholars

Figure 2 represents the ratio of gender in context to Ph.D. theses submitted to Shodhganga. The data have been extracted with the assistance of Gender API to figure out the gender. Gender-wise analysis shows that, among 1,126 scholars, 682 (60.56%) are males, and 444 (39.43%) are females. If we deeply observesupervisors' gender ratio in figure 3, we have found that males are 91.38% (n=1,029) and females are only 6.57% (n=74).

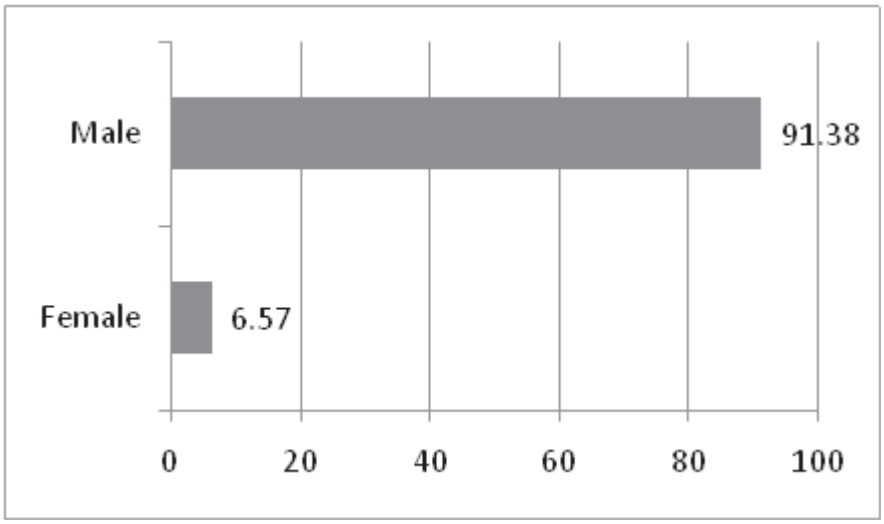

Figure 3: Gender-wise distribution of supervisor

5.5 *Contribution of the top five supervisors from selected universities*

Table 3: Contribution of the top five supervisors from selected universities

Sl No	Name of Supervisor/Guide	No. of Theses awarded under his/her supervision	Percentage
	Utkal university		
1	Ashutosh Pattanaik	45	5.70%
2	Basudeva Sahu	27	3.42%
3	K C Sahoo	25	3.16%
4	Rangadhar Nayak	22	2.78%
5	Baishnab Charan Samal	21	2.66%
	Sambalpur University		
1	Kumud Ranjan Panigrahi	23	8.88%
2	Bairagi Charan Jena	19	7.34%
3	Adikanda Sahoo	19	7.34%
4	Samar Mudali	18	6.95%
5	Brundabana Chandra Acharya	15	5.79%
	Berhampur University		
1	Devi Prasanna Patnaik	6	23.08%
2	Sameer Bhoi	5	19.23%
3	Sadananda Naik	4	15.38%
4	Lambodar Panigrahi	3	11.54%
5	Debiprasad Satapathy	3	11.54%

Table 3 reveals that Ashutosh Pattanaikis the leading research guide under whose guidance 45 theses have been awarded from Utkal University, followed by Basudeva Sahu (27), K. C Sahoo (25), Rangadhar Nayak (22), Baishnab Charan Samal (21) respectively. From Sambalpur University, Kumud Ranjan Panigrahi is the leading guide with 23 theses awarded under his supervision, followed by Bairagi Charan Jena and Adikanda Sahoo 19 each. Regarding Berhampur University, Devi Prasanna Patnaik is the leading guide with a score of 6 theses awarded under his supervision.

5.6 *Length and categories of the theses*

Table 4: Distribution of theses based on pages

Pages	No. of theses	Percentage
1-200	64	5.72%
201-400	708	63.27%
401-600	296	26.45%
601-800	43	3.84%
801-1000	8	0.71%
Total	1,119	100

Table 4 shows the distribution of the number of pages of theses uploaded to the Shodhganga repository. The highest 708 (63.27%) numbers of theses between 201-400 pages. Only 0.71% (n=8) of theses pages range between 801 to 1000 pages and 68.99% (n=772) of theses belong to 1-400 pages. Figure 4 shows that among 1,126 ETDs, 1091 were PhD theses (96.89%), 33 D.Litt. (2.93%) and two MA theses (0.17%).

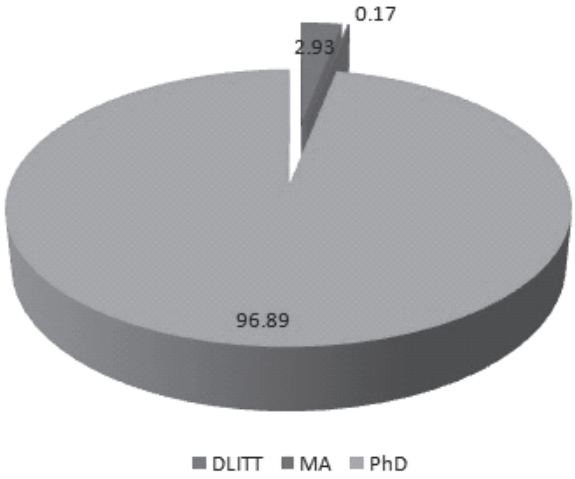

Figure 4:Category wise distribution of theses

5.7 *Frequency of the keyword occurrence*

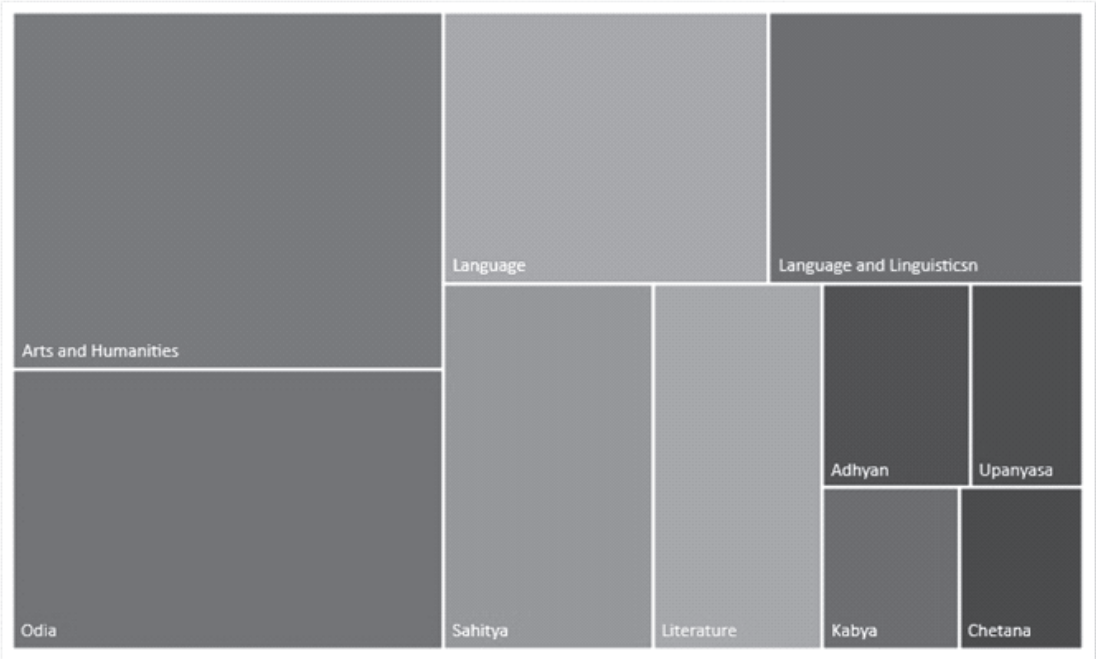

Figure 5: Frequency of the keyword occurrence

Figure 5 depicts the treemap of frequency of Odia theses keywords. The size of the rectangle and the inside the keywords represent the weight; the bigger the rectangle and words, the larger the weight. A total of 2,905 keywords were used in this study. Out of which the researchers mostly used keywords Arts and humanities, Odia, language, Language and Linguistics, Sahitya, Literature, Adhyan, Upanyasa, Kabya, Chetana. 'Arts and humanities' have been repeatedly used 154 (12.58%) times and occupied first rank. The word 'Odia' occupied second rank with frequently used 120 (9.80%) times, followed by language 88 (7.19%), Language and Linguistics 85 (6.94%), Sahitya 76 (6.21%), Literature 62 (5.07%), Adhyan 30 (2.45%), Upanyasa 23 (1.88%), Kabya 22 (1.80%), Chetana 20 (1.63%) respectively. The frequency of the top ten keywords is 55.56% of the total keywords.

6. Conclusion

There are currently 4,57,121 (19-05-2023) theses and dissertations contributed by 715 universities in India. The current paper presents the scenario of the universities of Odisha in Odia language and literature. Among the 8 universities, Utkal University is the oldest university with the highest number of faculties. It has predominated other 7 universities and taken place first position by contributing 70.15% highest number of theses. This study has analysed the gender ratio of scholars and supervisors in Odia language and found that 91.38% of the supervisors are male, followed by 60.57% of scholars are male. Keywords play a vital role in the retrieval of any scholarly communication and research area. This study also found that the top ten keywords occupied 55.6% of the total frequency. It also found no symmetry in the gender ratio as only 39.43 % of scholars and 6.57% of supervisors are female. However, many institutions of higher education and research in India, such as JNU, Delhi university, etc. facilitated Ph.D. courses in Odia language and literature. So, the future goal is to consider these universities, which can be studied with other parameters, i.e., citation analysis and metadata analysis of Shodhganga. Some nationally important institutions have maintained their ETD repositories that are not present in Shodhganga currently. So it also can be considered for future thrust.

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Role of Agricultural Information in Achieving Resilient Livelihood under Climate Change Scenario in Gosaba Block, Indian Sundarbans

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Abstract

This paper aims to examine the role of agricultural information in achieving livelihood resilience of two coastal communities in Indian Sundarbans under climate change scenarios. Field data were collected using quantitative and qualitative methods including a review of secondary data, group discussion and household survey with 378 tribal households of Gosaba block. The result revealed the level of households' vulnerability by analysing socio-demographic characteristics based on their household assets. This study also identifies the inhabitants of Sundarbans who seek various information at different stages of their farming, a variety of sources used to access information and what kinds of problems they face and lastly concludes with some adaptation strategies for a more sustainable future for their livelihoods. Therefore, this research will serve as an eye-opener for the government and policymakers, serving as a valuable instrument for formulating and executing necessary tactics to mitigate the susceptibility of impoverished individuals and facilitate their utilisation of resources and services to establish a resilient means of subsistence.

Keywords: Adaptation strategy, Climate change, Information, Livelihood, Resilience, Sundarbans, Tribes

1. Introduction

Climate change is silently but significantly altering the social and ecological dynamics of the coastal regions of the Indian Sundarbans, home to thousands reliant on natural ecosystems for their livelihoods and economic stability (IPCC, 2007). The region's vulnerability is compounded by frequent natural disasters like Aila, Fani, Bulbul, and Amphan. Traditionally, livelihoods in the coastal Sundarbans have relied on agriculture, fishing, aquaculture, and other renewable resources, with agriculture being predominant and fishing and aquaculture forming significant sources of income. However, the impact of climate change has rendered these livelihoods increasingly unsustainable (Human Development Report, 2009). Factors such as remote location, inadequate infrastructure, limited education, under utilisation of agricultural knowledge, and lack of access to modern technology exacerbate the region's instability. To cope, residents often migrate in search of work or resort to borrowing money from moneylenders, leading to deteriorating socio-economic conditions (Ghosh et al., 2016). Recognising the transformative power of information, particularly in empowering rural

communities to improve their socio-economic status and agricultural productivity (Babu et al., 2011), it becomes crucial to equip the coastal people of Sundarbans with contemporary farming techniques to address the challenges posed by unsustainable socio-economic circumstances and achieve consistent and sustainable agricultural development.

2. Literature review

The Sustainable Livelihood Framework (SLF) defines livelihood as the combination of capabilities, assets (including both material and social resources), and activities required for sustaining life (Sunny et al., 2020). A sustainable livelihood is capable of enduring and overcoming stresses while preserving or enhancing its capabilities and assets for both current and future generations, without depleting the natural resource base (Chambers & Conway, 1989). There are five essential key assets, namely natural, physical, human, financial, and social assets, which can be utilised to secure livelihoods by reducing instability. Access to these assets provides opportunities to enhance livelihood security and the capabilities of vulnerable individuals (Tora et al., 2022). Therefore, the framework assumes that when people's livelihoods are unable to cope with or adapt to various shocks or stresses, they become inherently vulnerable and fail to achieve livelihood resilience (Scoones, 2009).

To mitigate the escalating uncertainty resulting from climate change and establish stability, it is imperative to comprehend people's livelihoods by analysing the adaptive strategies employed at the local level by individuals or communities under adverse circumstances (Elasha et al., 2005). Consequently, the livelihood framework can be applied to comprehend the vulnerability of households or communities about their livelihood and how livelihood strategies can contribute to building adaptive capacity, thus enabling the affected households or communities to become resilient.

3. Objectives

i. To identify the underlying factors that contributes to the vulnerability of livelihood in the Sundarban region, as well as the subsequent impact on the livelihood assets of the inhabitance

ii. To investigate the precise role of information and the sources utilised in mitigating the needs associated with their livelihood

iii. To delve into the adaptation strategies employed by the islanders to achieve resilience and safeguard their sources of income.

4. Methodology

4.1 *Scope and coverage*

The Indian Sundarbans is located in the north and south 24 Parganas districts of the state of West Bengal. Gosaba block (21°54'N to 22°08'N and 88°29'E to 88°49'E) is located at the fringe of the Sundarbans Mangrove Forest in the district of South 24 Parganas (Anon, 2021). It is one of the most vulnerable disaster-prone areas of Sundarban and upholds a real portrait of people's struggle and survival strategies (Dutta et al., 2021). Another reason behind selecting the block is nearly 70% of the inhabitance is dependent on agriculture and rest is involves in fishing and prawn seed collection (Dasgupta and Shaw, 2014).

4.2 *Sample size and sampling procedures*

The study populations of this study are the smallholder farmers, fishermen, prawn seed and crab collectors who are traditionally backward and marginalised group of the Sundarbans.

To determine the sample size Cochran formula is used. When the total population is known then the formula is as follows:

$$n = (z^{\wedge 2} * p * q / e^{\wedge 2}) / 1 + (z^{\wedge 2} * p * q / e^{\wedge 2} * N)$$

Where: n= sample size; Z= Z value from standard normal distribution (e.g., 1.96 for a 95% confidence interval); p= the proportion of the population i.e. 0.5;q=1-p means (1-0.5); e= desired margin of error (, e.g., 0.05 for a 5% margin of error); N= ST population of Gosaba block (23,343 as per census 2011) (Census, 2011)

Here, n= {(1.96)2*(0.5) (0.5) /(0.05)2}/1+{(1.96)2*(0.5) (0.5) /(0.05)2*23,343}

=377.94

Roundly 378 tribal household are selected as sample population. Snowball sampling is used to identify the target population to participate for interview.

4.3 *Data collection methods*

Primary data were gathered through structured interviews, and focus group discussions (FDGs). Secondary data was collected using several sources mostly from peer-reviewed articles, newspaper articles, case studies and local government document like district gazetteer of South 24 Parganas, Reports, and Census 2011, etc.

Household survey was conducted using closed-ended structured questionnaire on a face-to-face mode to order to avoid biasness. Households were interviewed during the period of February-April, 2023 and lasted 10-15 minutes per household. Apart from the questionnaire survey, the focus group discussion (FGD) also organised to cross check the accuracy of data.

4.4 *Data analysis*

All the data from interviews and focus groups were accumulated and analysed. The analysis of household survey data was carried out using IBM SPSS Statistics 21andcount, percentages, tables, and charts were used for easy understanding.

5. Results and discussion

5.1 *Demographic characteristics*

Demographic characteristics and Individual's own asset base work as a mirror to represent the socio-economic scenario of a community (Dutta et al., 2021).

Table 1: Demographic data of respondents

Variable	Livelihood	Attributes	Count	Percentage
Gender	*Farming*	*Male*	168	84.0
		Female	32	16.0
	Fishing	*Male*	133	74.7
		Female	45	25.2
Age	*Farming*	*15-30*	41	20.5
		31-45	73	36.5
		46-60	66	33.0
		More than 60	20	10.0
	Fishing	*15-30*	27	15.1
		31-45	84	47.1
		46-60	45	25.2
		More than 60	22	12.3

Variable	Livelihood	Attributes	Count	Percentage
Marital Status	*Farming*	*Married*	155	77.5
		Unmarried	19	9.5
		Widow or Widower	26	13
	Fishing	*Married*	131	73.5
		Unmarried	14	7.8
		Widow or Widower	33	18.5
Family Type	*Farming*	*Nuclear*	178	89.0
		Join	22	11.0
	Fishing	*Nuclear*	153	85.9
		Join	14	7.8

(Source: Computed by the authors)

As per table 1,84% of the 200 farmers were male and 16% were female whereas, for 176 fishers, 74.7% were male. Both for farmers and fishers, most of the respondents were from middle age group (70.89%) i.e. 31-60. Majority of the respondents were married (75.66%) and belong from nuclear families (87.57%).

5.2 *Livelihood assets of the respondents*

5.2.1 *Natural assets*

Natural assets include environmental resources, wild life etc.

5.2.2 *Human assets*

Human Assets represents the ability, knowledge, experience, work skills and good health, etc. (UNDP, 2017).

Table 2: Human assets of respondents

Variable		Attribute	Count	Percentage
Education	Farmers	Primary	67	33.5
		Upper Primary	38	19.0
		Secondary	19	9.5
		Higher secondary	9	4.5
		Graduation and above	7	3.5
		Uneducated	60	30.0
	Fishermen	Primary	51	28.6
		Upper Primary	32	17.9
		Secondary	13	7.3
		Higher secondary	7	3.9
		Graduation and above	9	5.0
		Uneducated	66	37.0
Main Occupation	Farming	Farmer	139	69.5
		Agriculture Labor	61	30.5
	Fishing	Fisher	137	76.9
		Meen and Crab collector	41	23.0

Variable		Attribute	Count	Percentage
No. of income generating activities	Farming	One	38	19.0
		Two	94	47.0
		More than two	68	34.0
	Fishing	One	54	30.3
		Two	77	43.2
		More than two	47	26.4
Active earning member of a family	Farming	One	74	37.0
		Two	86	43.0
		More than two	40	2.0
	Fishing	One	59	33.1
		Two	74	41.5
		More than two	45	25.2

(Source: Computed by the authors)

Table 2 reveals that the majority of participants either lacked formal education (33.33%) or had only completed primary schooling (31.21%). While not essential for sustenance, education aids in adapting to new technology and making informed decisions. Regarding occupation, many respondents pursued multiple activities. Only 24.33% relied on a single income source, indicating the need for additional financial support. Consequently, most households, including children, contributed to income generation, with 42.32% having two breadwinners.

5.2.3 *Financial assets*

Financial resource represents income from livelihoods, includes savings, investments, credits, pension, remittances, etc. (Lax and Krug, 2013).

Table 3: Financial assets of respondents

Variable	Livelihoods	Attribute	Count	Percentage
Average Income	Farming	1k-7k	96	48.0
		7.1k-14k	70	35.0
		More than 14k	34	17.0
	Fishing	1k-7k	101	56.7
		7.1k-14k	54	30.3
		More than 14k	23	12.9
Access to credit	Farming	bad	156	78.0
		Good	44	22.0
	Fishing	bad	128	71.9
		Good	50	28.1

(Source: Computed by the authors)

Table 3 summaries that, 51.28% of the respondents have earned within 7000 monthly, whereas, only 15.07% have earn more than 14k/month. However, the credit facility of the Sundarbans also was bad (75.13%) enough. The main source of cash credit comes from moneylenders, NGOs or bank. The condition of cooperative also was not so good here.

5.2.4 *Physicalassets*

Physical assets such as roads, schools, houses, and access to technology, can enhance productivity and foster economic growth (Lax and Krug, 2013).

Table 4: Physical assets of respondents

Variable	Livelihoods	Attribute	Count	Percentage
House	Farming	Pakka	42	21.0
		Semi-pakka	75	41.5
		Kacha	83	37.5
	Fishing	Pakka	30	16.9
		Semi-pakka	62	49.4
		Kacha	88	34.8
Communication and Transport facility	Farming	Pakka	100	50.0
		Semi-pakka	76	38.0
		Kacha	24	12.0
	Fishing	Pakka	60	33.7
		Semi-pakka	97	54.4
		Kacha	21	11.8

(Source: Computed by the authors)

From table 4, it is found that most of the people of study villages lived in either kacha (45.23%) or semi-pakka (36.24%) house. Very few of them (19.04%) lived in pakka houses. Inter-village communication of the Sundarbans was mainly water-based and transport facility was not satisfactory. Developed communication system can help for easy market access, which is necessary to improve economic status.

5.2.5 *Social assets*

Social asset encompasses the social networks, relationships, and social support, which can create economic opportunities and foster resilience during times of crisis (Davis, 2000).

Table 5: Social assets of respondents

Variable	Livelihoods	Attribute	Count	Percentage
Kin Network	Farming	Good connectivity	174	87.0
		Bad connectivity	26	13.0
	Fishing	Good connectivity	165	92.6
		Bad connectivity	13	7.3
Community Network	Farming	Good connectivity	71	35.5
		Bad connectivity	129	64.5
	Fishing	Good connectivity	63	35.3
		Bad connectivity	115	64.6

(Source: Computed by the authors)

Table 5 has revealed that kin network of the Sundarbans (89.68%) was very strong means respondents interact with their friends/ neighbours on a regular basis on common issues, interests or needs. In case of community network, sometimes village meetings (35.45%) were organised on various issues, but most of them were biased by influential or political persons.

6. *Socio-economic dynamics of the Sundarbans*

The Sustainable Livelihood Approach (SLA) is instrumental in assessing the respondents' current status. In the Sundarbans, economic, natural, and physical assets are particularly vulnerable to climate variability, reducing adaptive capacity. However, social connectivity remains strong. Human assets suffer due to limited training, skills in alternative income generation, and knowledge, leading to reliance on high-interest loans from moneylenders. Inadequate infrastructure, market facilities, and limited access to credit pose significant threats to life and livelihood. If this community could be enriched with livelihood asset by overcoming all uncertainty, then the overall standard of life will be improved. To realise, information can play a crucial role for executing developmental and welfare activities in this coastal area in a planned way.

7. *Information facilitates overcoming livelihood vulnerability*

Information emerges as a crucial resource across all aspects of human development (Uzezi, 2015). The economic sector of the Sundarbans is heavily influenced by weather conditions, directly impacting those reliant on agriculture and fishing for livelihoods (IPCC, 2012). In this context, socio-economic empowerment through information is vital to combat chronic poverty and hunger.

7.1 *Climate change perceptions of the respondents*

This section explores the respondent's perceptions of climate change.

7.1.1 *Awareness about climate change*

Information on climate change and its impacts on coastsuch as awareness about rising sea levels, changing weather patterns, can help the community to follow necessary adaptation strategies and sustainable practices.

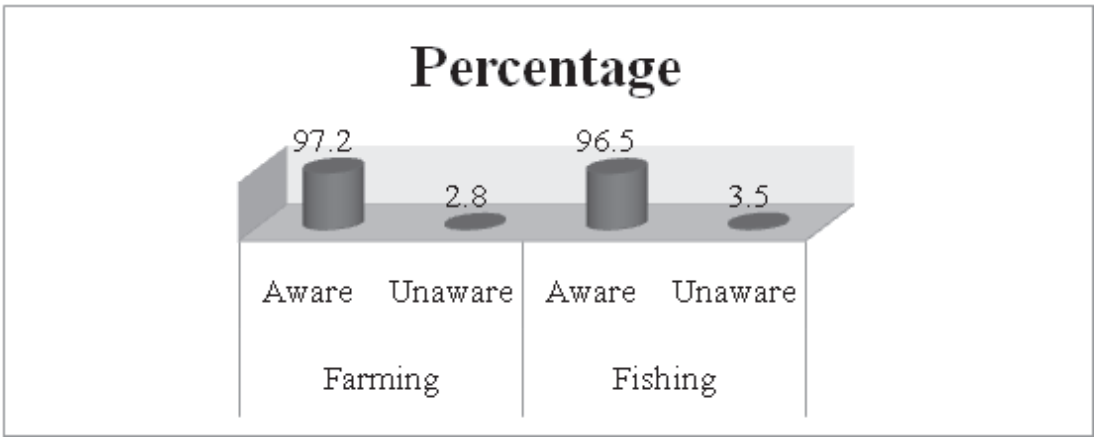

Figure 1: Awareness about climate change

This study shows that, 97.2 % of farmers and 96.5 % of fishers were sufficiently aware about the concept of climate change.

7.1.2 ***Early-warning before devastating cyclones***

Effective early warning system is essential to empower threaten communities timely, for reducing the impact of looming hazards on their lives and livelihoods (Gondwe, 2019).

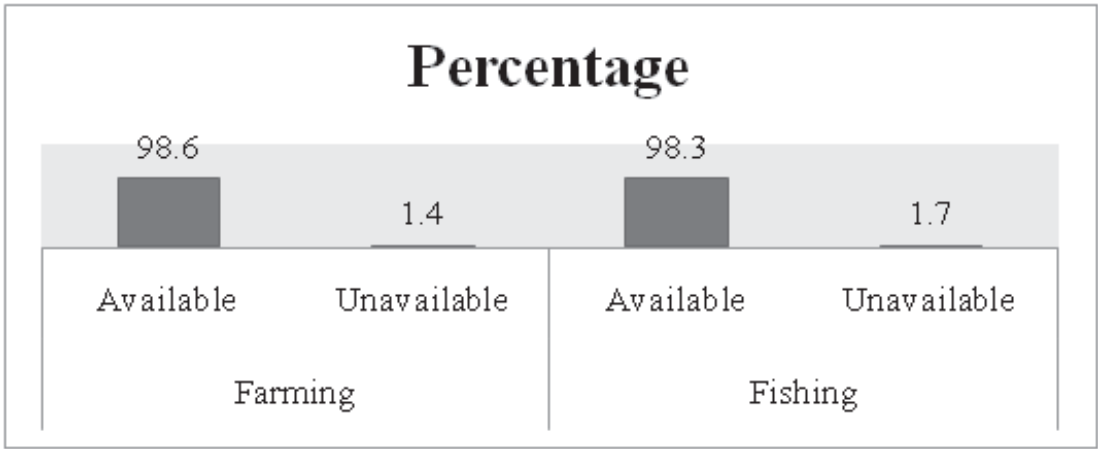

Figure 2: Early-warning before cyclone

This study disclosed that, 98.6% of farmers and 98.3% of fishers of the surveyed population were received early warning before natural calamities.

7.1.3 *Sources of climate information*

Table 6: Sources of climate information

Sources	For Farmers (200)		For Fishers (178)	
	Count	Percentage	Count	Percentage
Formal Sources	29	14.5	21	11.7
Informal Sources	131	65.5	136	75.8
Documental Sources	5	02.5	8	04.5
Mass media	103	51.5	91	51.1
Others	16	8.0	11	6.1

(Source: Computed by the authors)

According to table 6, respondents prefer informal sources (70.63%) and mass media (51.32%) for getting climate information than other sources.

7.2 *Types of information they seek at various stages of their livelihoods*

Generations of Sundarbans residents have traditionally relied on farming and fishing, yet changing climate conditions present novel challenges, exacerbated by a lack of guidance on addressing these uncertainties. To navigate these challenges effectively, they require access to concise, processed climatic, technical, and regulatory information to manage their fields across various stages (Just & Zilberman, n.d.).

7.2.1 *Farmers' information needs*

Table 7: Farmers information needs

Types	Count	Percentage
Salt tolerance rice Variety	10	5.0
Crop according to soil	153	76.5
Alternative cash crops	110	55.00
Pesticides/ Insecticides	142	71.00
Market price	108	54.0
Agricultural Loan	39	19.5
New technology andequipments	10	5.0

(Source: Computed by the authors)

As per table 7, under this changing weather patterns farmers generally seek information on crop according to soil quality (76.5%), information about pesticides/ insecticides uses (71.0%), market price (54%) and alternative cash crops (55%) than other information.

7.2.2 *Fisherman information needs*

Table 8: Fisherman information needs

Types	Count	Percentage
Fishing equipments	69	38.76
Market prices	146	82.02
Modern equipment and technology	08	04.49
Packaging and export	12	06.74
Agricultural Loan	78	43.82

(Source: Computed by the authors)

According to table 8, fishers seek information on market prices (82.02%), fishing equipments (38.76%), and loan related queries (43.82%) more than other information.

7.2.3 *Sources of information*

Table 9 : Sources of information

Sources	For Farmers(200)		For Fishers(176)	
	Count	Percentage	Count	Percentage
Mass media	83	41.5	58	32.58
Documentary Sources	9	04.5	6	03.37
Informal sources	138	69.0	124	69.66
Village meeting	48	24.00	67	37.64
Govt. Officers	16	8.00	28	15.73
Insecticides/ Pesticides shops	169	84.5	142	79.78
Market area	36	18.0	40	22.47
Own experience	179	89.50	137	76.96

(Source: Computed by the authors)

As per table 9, respondents generally prefer own experience (83.6%), informal sources (69.31%), insecticides/ pesticides shops (82.27%), and mass media (37.3%) more reliable than other sources to meet their needs.

7.2.4 *Problem faced due to shortage of information*

Table 10: Barriers of information seeking

Type of Stresses	For Farmers		Type of stresses	For Fishers	
	Count	Percentage		Count	Percentage
Lack of Knowledge	129	64.5	Lack of Knowledge	113	63.48
Ignorance about information sources	118	59.00	Ignorance about information sources	156	87.64
Lack of extension officers	153	76.5	Lack of extension officers	130	73.03
Poor income	167	83.5	Lack of financial advices	107	60.11
Others	56	28.00	Others	41	23.03

(Source: Computed by the authors)

This finding (Table 10) has highlighted that majority of respondent faced problem due to shortage of information. Among them, ignorance about information sources (72.49%) and lack of extension offices (74.87%) were the major concern. To overcome the above obstacle, coastal people adopt various strategies to achieve resilience in their livelihoods.

8. Information about sustainable adaptation strategy to achieve livelihood resilience

Information regarding sustainable adaptation strategies for achieving livelihood resilience is essential. Adaptation, defined as actions that reduce vulnerability and increase resilience, is crucial in various areas of the coastal Sundarbans. These strategies include livelihood diversification, which involves establishing a diversified portfolio of livelihoods to enhance resilience against shocks and alleviate poverty (Jayaweera, 2010). Studies indicate that current livelihood activities in the region are no longer economically, socially, or environmentally sustainable and require alternative options (Table-4). Migration is another prominent strategy, with a significant number of farming and fishing households migrating annually to states such as Kerala, Karnataka, Maharashtra, Gujarat, Orissa, and Assam in search of work (Mistri, 2013). Additionally, reintroducing salt-tolerant rice varieties like Dudheswar, Getu, Taalsaree, Matla, Hamilton, Lal Swarna, and Nona-swarna (Misra & Mitra, 2020), as well as promoting salt-tolerance fish cultivation in brackish water bheries, which traditionally support species such as mullets, Asian sea bass, Nona Tangra, Parsia, Milkfish, catfish, and tiger shrimp (Mallappa & Shirurr, 2021), are vital strategies in ensuring the resilience of livelihoods in the Sundarbans.

9. Conclusion

The inevitability of climate change on earth has been proven and the coastal communities of the Sundarbans are at the forefront of experiencing its impact. In order to alleviate poverty and preserve the natural resources of the Sundarbans, it is imperative to implement a climate-resilient livelihood strategy. Despite facing challenges such as limited resources and skills, all stakeholders in the Sundarbans have made concerted efforts. However, these initiatives have been unsuccessful due to a lack of coordination between the local population, governance, and policymakers. In order to foster a conducive environment for resilient livelihoods, it is crucial to ensure equal collaboration and participation from all stakeholders.

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Departmental Websites of Central Government Ministries of India: a webometric study

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Abstract

To measure the visibility, performance, and link quality of departmental websites under central government ministries of India, the study looked at the websites of India's ministries' departments. The required data have been collected by applying web-based survey and observation methods. Different webometric tools and approaches have then been used to analyse and tabulate the collected data. The current study has examined the domain structure, number of webpages, and link pages of the existing departmental websites under different ministries of India. It has further calculated the simple web impact factor (WIF), the self-link WIF, and the external link WIF and ranked the websites based on the score of different WIFs. A link network diagram is also prepared which shows the links among the selected central government departmental websites. The study reveals that 89.47% of websites use gov.in extension and only 10.53% of websites carry nic.in domain extension. The website of Department of Food & Public Distribution (DoFPD) got the highest position with 196 link pages, only one web page and 196 Simple WIF. This study will assist in making guidelines for website development and be helpful to further research in the field of webometric evaluation.

Keywords: Central government departmental websites, Google page rank, Webometrics, Webometric evaluation, Web Impact Factor,

1. Introduction

It is a prerequisite for every administrative entity to make a website with the occurrence of Internet and Information and Communication Technology (ICT). An administrative body can use the least amount of effort and time by having a website to reach the greatest number of people. Having a personal, functional website is therefore essential for the administration. Additionally, even though its sub-bodies may be located in topographically dispersed locations, a site enables an administrative body to assemble all of its data. Therefore, integrating ICT into government organisations can result in the advancement of the executive branch. Governments of all countries make data accessible to citizens via a variety of channels to add a level of transparency, to emphasise responsibility, and bring their accomplishments to the attention of the general populace. Natives make decisions about the degree of certainty and success of governments using this information (Chand & Ramesha, 2017).

The words "web" and "metrics" are the roots of the term "webometrics". The web is described in the dictionary of science as a hypermedia system that enables users to see

and obtain information from documents that contain links. Metrics are systems of measurement, specifically evaluations of the validity and usefulness of digital resources. The analysis of web-related topics in a quantitative manner is called webometrics. It focuses on measuring various characteristics of the web, including websites, web pages, individual web page components, phrases inside web pages, etc. (Verma & Brahma, 2017).

2. Review of literature

Experiments were conducted evaluating e-government websites' effectiveness, efficiency, and user satisfaction through usability testing and a new assessment framework (Darem, 2013). Six parameters were proposed for analysing Indian government websites, finding adherence to identifier guidelines but low scores in services and participation (Chand & Ramesha, 2017; Brooks & Persaud, 2015). The importance of service emphasised quality in e-government, highlighting its impact on citizen engagement and public administration (Bhattacharya, 2014). Past literature has extensively examined the usability and interaction of academic and government websites, particularly focusing on e-government services' performance. This study aims to analyse Indian central government ministry websites using webometric tools.

3. Objectives of the study

The main research objectives are:

I. to figure out the number of web pages, simple link pages, self-link pages, and external link pages on the websites of central government ministries' departments in India

ii. to examine the effectiveness of links on Indian government departmental websites

iii. to locate and classify the domain names of India's central government departments' websites

iv. to find out the websites' online Impact Factors

v. to rank the concerned websites under study according to different Web Impact Factors.

4. Scope of the study

As per the information presented by the integrated government online directory of India (https://igod.gov.in/), there are 52 central government ministries, of which 19 ministries have their department/ departments. These ministries' departments are 52 in total number and they are accountable for performing different activities under their parent ministries. The departmental websites with separate domain names have been included in this study; that's why the study covers only 38 departmental websites.

5. Methodology

The required data have been collected by applying web-based survey and observation techniques, from the selected departmental websites. In the next stage, different webometric tools and approaches have been used to analyse and tabulate the collected data. The total number of pages from each website was counted using the Google search engine; the chosen search term was, site : url of the website for instance, site: https://dare.gov.in/

Website Link Analyzer (https://smallseotools.com/website-link-analyzer-tool/) has been used to extract simple links, self or internal links and external links from every department's website under study.

6. Web Impact Factor (WIF)

The Web Impact Factor is a tool for evaluating the value of websites based on the links that point to them. The number of webpages and links to a website are necessary for calculating WIF. The concerned study uses three different kinds of WIFs, which are described below:

Simple-WIF = No of Linked Pages/ No of webpages - reported by the search engine Google

External Link-WIF = No of External Linked Pages/ No of webpages - reported by the search engine Google

Self Link-WIF = No of Self-Linked Pages/ No of webpages - reported by the search engine Google

(Hadagali, Bulla &Shettar, 2021).

Table 1: List of ministries' departments with their website addresses

Sl. No.	Central government ministries' departments	Website address
1	Department of Administrative Reforms & Public Grievances (DoARPG)	https://darpg.gov.in/en
2	Department of Agriculture & Farmers Welfare (DoAFW)	https://agricoop.nic.in/en
3	Department of Agricultural Research and Education (DoARE)	https://dare.gov.in/
4	Department of Animal Husbandry and Dairying (DoAHD)	https://dahd.nic.in/
5	Department of Biotechnology (DoB)	https://dbtindia.gov.in/
6	Department of Chemicals and Petrochemicals (DoCPC)	https://chemicals.gov.in/
7	Department of Commerce (DoC)	https://commerce.gov.in/
8	Department of Consumer Affairs (DoCA)	https://consumeraffairs.nic.in/
9	Department of Defence Production (DoDP)	https://www.ddpmod.gov.in/
10	Department of Drinking Water and Sanitation (DoDWS)	https://jalshakti-ddws.gov.in/en
11	Department of Economic Affairs (DoEA)	https://dea.gov.in/
12	Department of Empowerment of Persons with Disabilities (DoEPD)	https://disabilityaffairs.gov.in//content/
13	Department of Expenditure (DoE)	https://doe.gov.in/
14	Department of Ex-servicemen Welfare (DoEW)	https://www.desw.gov.in/
15	Department of Fertilizers (DoFz)	https://www.fert.nic.in/
16	Department of Financial Services (DoFS)	https://financialservices.gov.in/
17	Department of Fisheries (DoF)	https://dof.gov.in/

Sl. No.	Central government ministries' departments	Website address
18	Department of Food & Public Distribution (DoFPD)	https://dfpd.gov.in/index.htm
19	Department of Health Research (DoHR)	https://dhr.gov.in/
20	Department of Investment and Public Asset Management (DoIPAM)	https://dipam.gov.in/
21	Department of Justice (DoJ)	https://doj.gov.in/
22	Department of Land Resources (DoLR)	https://dolr.gov.in/
23	Department of Legal Affairs (DoLA)	https://legalaffairs.gov.in/
24	Department of Official Language (DoOL)	https://rajbhasha.gov.in/
25	Department of Pension & Pensioners' Welfare (DoPPW)	https://doppw.gov.in/en
26	Department of Personnel & Training (DoPT)	https://dopt.gov.in/#
27	Department of Pharmaceuticals (DoPh)	https://pharmaceuticals.gov.in/
28	Department of Posts (DoP)	https://www.indiapost.gov.in/vas/Pages /IndiaPostHome.aspx
29	Department for Promotion of Industry and Internal Trade (DPIIT)	https://dpiit.gov.in/
30	Department of Public Enterprises (DoPE)	https://dpe.gov.in/
31	Department of Revenue (DoR)	https://dor.gov.in/
32	Department of School Education & Literacy (DoSEL)	https://dsel.education.gov.in/
33	Department of Science & Technology (DoST)	https://dst.gov.in/
34	Department of Scientific and Industrial Research (DoSIR)	http://www.dsir.gov.in/

7. Analysis and interpretation of data

7.1 *Distribution of departments' websites by domain*

A domain name consists of the name of a website and the specific domain extension.

Table 2: Websites using specific domain extensions

Domain names	Number of government departmental websites	Percentage (%)
gov.in	34	89.47
nic.in	04	10.53

Table 2 depicts the distribution of domains among central government departmental websites of India. It exhibits that two types of domain name (i.e. gov.in and nic.in) have been used by the concerned websites. 34 (89.47%) departmental websites use the domain gov.in whereas only 4 (10.53%) websites follow nic.in extension.

7.2 *Simple WIF of departmental websites*

Table 3 displays the Simple Web Impact Factor. It displays the link pages for departmental websites together with their rank distribution as per Simple WIF. The score of Simple WIF (B/A) of each website is taken by dividing the number of link pages (B) by total number of web pages (A) of a website.

Table 3: Simple WIF of departmental websites

Sl. No.	Name of Departmental Websites	Number of web Pages (A)	Number of Link pages (B)	Simple WIF (B/A)	Rank by Simple WIF
1	DoFPD	01	196	196	01
2	DoP	02	108	54	02
3	DoPPW	127	99	0.779	03
4	DoARPG	428	182	0.425	04
5	DoIPAM	557	187	0.335	05
6	DoDP	708	125	0.176	06
7	DoJ	1710	263	0.153	07
8	DoWRRDGR	2140	292	0.136	08
9	DoC	5400	567	0.105	09
10	DoF	2130	200	0.093	10
11	DoSJE	2020	169	0.083	11
12	DoSEL	2390	169	0.070	12
13	DoSIR	3250	214	0.065	13
14	DoFz	2690	172	0.063	14
15	DoPT	550	352	0.063	14
16	DoB	4180	235	0.056	15
17	DoAFW	3400	188	0.055	16
18	DoEW	3200	133	0.041	17
19	DoCPC	4350	177	0.040	18
20	DoR	3680	140	0.038	19
21	DoE	8080	173	0.021	20
22	DoPh	6510	130	0.019	21
23	DoEA	8910	167	0.018	22
24	DoFS	7120	133	0.018	22
25	DoST	9760	179	0.018	22
26	DoPE	11600	201	0.017	23
27	DoAHD	9810	144	0.014	24
28	DoDWS	71	01	0.014	24
29	DoLR	11300	141	0.012	25
30	DoCA	63000	690	0.010	26
31	DoOL	11200	118	0.010	26
32	DoLA	14000	125	0.008	27
33	DPIIT	24700	209	0.008	27
34	LD	13200	108	0.008	27
35	DoT	75100	338	0.004	28
36	DoHR	1290	NF	--	--
37	DoARE	1150	NF	--	--
38	DoEPD	NF	236	--	--

Table 3 shows that the website of DoFPD got the highest position with 196 link pages, only one web page and 196 Simple WIF. Second rank has been occupied by DoP with 108 link pages, 2 web pages and 54 Simple WIF. The website of DoPPW secured 3rd rank with 99 link pages, 127 web pages and 0.779 Simple WIF. Fourth and fifth rank has been taken by the website of DoARPG and DoIPAM with 0.425 and 0.335 Simple WIF respectively. DoF has got 10th position with 0.093 Simple WIF. The websites of DoFz and DoPT have got 14th rank with a score of 0.063. 22nd position is occupied by the websites of three departments- DoEA, DoFS and DoST with 0.018 Simple WIF. The websites of DoAHD and DoDWS have been placed in 24th position with a score of 0.014. Three websites, DoLA, DPIIT and LD have got 27th rank with a score of 0.008. The website of DoT is placed in the last position with 338 link pages, 75100 webpages and 0.004 Simple WIF.

7.3 *External link WIF of departmental websites*

Table 4 displays External Link WIF of departmental websites. Here, A and C stand for the websites' number of total web pages and total number of externally linked web pages, respectively. The score of External Link WIF (C/A) for each website is derived by dividing the entire number of externally linked web pages (C) by the number of total web pages (A).

Table 4: External link WIF of departmental websites

Sl. No.	Name of Departmental Websites	Number of Web pages (A)	Number of External Linked Web pages (C)	External Link WIF (C/A)	Rank by External link WIF
1	DoFPD	01	33	33	01
2	DoP	02	13	6.5	02
3	DoPPW	127	52	0.409	03
4	DoARPG	428	44	0.102	04
5	DoJ	1710	121	0.070	05
6	DoDP	708	31	0.043	06
7	DoSJE	2020	57	0.028	07
8	DoPT	5550	145	0.026	08
9	DoF	2130	51	0.023	09
10	DoWRRDGR	2140	49	0.022	10
11	DoSEL	2390	48	0.020	11
12	DoAFW	3400	55	0.016	12
13	DoB	4180	53	0.012	13
14	DoC	5400	68	0.012	13
15	DoEW	3200	38	0.011	14
16	DoR	3680	43	0.011	14
17	DoSIR	3250	31	0.009	15
18	DoCPC	4350	38	0.008	16
19	DoCA	63000	497	0.007	17
20	DoEA	8910	45	0.005	18
21	DoFS	7120	41	0.005	18
22	DoIPAM	557	03	0.005	18
23	DoAHD	9810	43	0.004	19
24	DoPE	11600	57	0.004	19

Sl. No.	Name of Departmental Websites	Number of Web pages (A)	Number of External Linked Web pages (C)	External Link WIF (C/A)	Rank by External link WIF
25	DoPh	6510	30	0.004	19
26	DoE	8080	27	0.003	20
27	DoLR	11300	39	0.003	20
28	DoST	9760	39	0.003	20
29	DoFz	2690	07	0.002	21
30	DoLA	14000	39	0.002	21
31	DoOL	11200	31	0.002	21
32	DPIIT	24700	51	0.002	21
33	LD	13200	27	0.002	21
34	DoT	75100	101	0.001	22
35	DoHR	1290	NF	--	--
36	DoARE	1150	NF	--	--
37	DoDWS	71	NF	--	--
38	DoEPD	NF	42	--	--

The External link WIFs of all central government departmental websites in this study have been depicted in table 4. The websites are ranked based on their scores. The website of DoFPD has taken the first rank with 1 web page, 33 external linked web pages and 33 External link WIF. Second rank is taken by the website of DoP with 2 web pages, 13 external linked web pages and 6.5 External link WIF. Third and fourth positions have been occupied by the websites of DoPPW and DoARPG with 0.409 and 0.102 External link WIFs respectively. The websites of two departments, DoB and DoC got 13th position with 0.012 External link WIF. The websites of DoEA, DoFS and DoIPAM occupy 18th rank with 0.005 External link WIF. Twenty first position is occupied by the websites of five departments - DoFz, DoLA, DoOL, DPIIT and LD with 0.002 External link WIF. The website of DoT has been placed in last rank i.e. 22nd with 75100 web pages, 101 external linked web pages and 0.001 External link WIF.

7.4 *Self link WIF of departmental websites*

Table 5 exhibits the individual score and rank (based on Self Link WIF) of each departmental website under study. In this table, A denotes a total number of web pages, and D denotes a total number of self-linked web pages inside the websites. The score of Self link WIF of each website is retrieved by dividing the number of self-linked web pages (D) by a number of web pages (A). Websitesare rated as per the scores of Self link WIFs.

Table 5: Self link WIF of departmental websites

Sl. No.	Name of Departmental Websites	Number of Web pages (A)	Number of Self linked web pages (D)	Self-link WIF (D/A)	Rank by Self Link WIF
1	DoFPD	01	163	163	01
2	DoP	02	95	47.5	02
3	DoPPW	127	47	0.370	03
4	DoIPAM	557	184	0.330	04
5	DoARPG	428	138	0.322	05
6	DoDP	708	94	0.132	06
7	DoWRRDGR	2140	243	0.113	07
8	DoC	5400	499	0.092	08
9	DoJ	1710	142	0.083	09
10	DoF	2130	149	0.069	10
11	DoFz	2690	165	0.061	11
12	DoSIR	3250	183	0.056	12
13	DoSJE	2020	112	0.055	13
14	DoSEL	2390	121	0.050	14
15	DoB	4180	182	0.043	15
16	DoAFW	3400	133	0.039	16
17	DoPT	5550	207	0.037	17
18	DoCPC	4350	139	0.031	18
19	DoEW	3200	95	0.029	19
20	DoR	3680	97	0.026	20
21	DoE	8080	146	0.018	21
22	DoPh	6510	100	0.015	22
23	DoDWS	71	01	0.014	23
24	DoST	9760	140	0.014	23
25	DoEA	8910	122	0.013	24
26	DoFS	7120	92	0.012	25
27	DoPE	11600	144	0.012	25
28	DoAHD	9810	101	0.010	26
29	DoLR	11300	102	0.009	27
30	DoOL	11200	87	0.007	28
31	DoLA	14000	86	0.006	29
32	DPIIT	24700	158	0.006	29
33	LD	13200	81	0.006	29
34	DoCA	63000	193	0.003	30
35	DoT	75100	237	0.003	30
36	DoHR	1290	NF	--	--
37	DoARE	1150	NF	--	--
38	DoEPD	NF	194	--	--

Table 5 exhibits the Self link WIFs of the departmental websites with their ranks. It is showing that the website of DoFPD occupies the first rank with 1 web page, 163 Self linked web pages and 163 Self link WIF. DoP and DoPPW have been placed in second and third position with 47.5 and 0.370 Self link WIFs respectively. The fifth rank is taken by DoARPG with 428 web pages, 138 Self linked web pages and 0.322 Self link WIF. The website of DoF gets tenth rank with 2130 web pages, 149 Self linked web pages and 0.069 Self link WIF. Twenty third position is occupied by the websites of DoDWS and DoST with 0.014 Self link WIF. The websites of DoLA, DPIIT and LD got 29th rank with

0.006 Self link WIF. The lowest rank is taken by the websites of DoCA and DoT with 0.003 Self link WIF.

7.5 *Google's page rank and domain authority*

Google uses the Page Rank algorithm to rank the webpages of various websites in their search engine results. Through the use of this method, website page importance can be determined.

A site's performance in search engine results can be determined by its domain authority, a factor in search engine rankings. It provides a general summary of anticipated search engine performance and was developed by the software development company Moz. It assigns websites a score between 1 and 100, with the higher number indicating a better result.

Table 6: Domain authority, page authority and page rank of departmental websites

Sl. No.	Name of Departmental Websites	Domain Authority	Page Authority	Page Rank (out of 10)
1	DoAFW	53	58	06
2	DoP	59	58	06
3	DoST	57	56	06
4	DoT	58	54	06
5	DoAHD	47	50	05
6	DoB	47	47	05
7	DoC	51	52	05
8	DoCA	48	47	05
9	DoEA	49	48	05
10	DoFS	42	51	05
11	DoPT	42	48	05
12	DoSEL	60	42	05
13	LD	51	48	05
14	DoARPG	35	45	04
15	DoDP	34	41	04
16	DoDWS	38	43	04
17	DoE	41	44	04
18	DoEPD	42	43	04
19	DoEW	38	41	04
20	DoF	33	42	04
21	DoFPD	44	41	04
22	DoFz	34	44	04
23	DoHR	35	42	04
24	DoIPAM	37	40	04
25	DoJ	41	45	04
26	DoLA	36	42	04
27	DoLR	32	39	04
28	DoOL	33	45	04
29	DoPE	37	43	04

Sl. No.	Name of Departmental Websites	Domain Authority	Page Authority	Page Rank (out of 10)
30	DoPh	38	43	04
31	DoR	40	47	04
32	DoSIR	35	40	04
33	DoSJE	32	39	04
34	DoWRRDGR	36	41	04
35	DPIIT	38	45	04
36	DoARE	26	28	03
37	DoCPC	22	28	03
38	DoPPW	28	38	03

Table 6 highlights the score of individual departmental websites under Domain Authority, Page Authority and Google's Page Rank. The highest score i.e. 60 according to Domain Authority has been occupied by the website of DoSEL. The websites of DoAFW and DoP secured the highest score 58 under Page Authority. According to Google's Page Rank, the top score i.e. 6 is taken by the websites of DoAFW, DoP, DoST and DoT.

7.6 *Link mapping of websites*

The popular website link analyser, smallseotools (https://smallseotools.com/website-link-analyzer-tool/) has been utilised to gather required data from the selected central government departmental websites of India.The task of web harvesting was conducted from 11th - 13th July, 2023. Well-knowngraph visualisation software Graph Viz has been used in this study for making link network diagrams of the selected websites under study. Figure1 represents the network diagram which shows links (mainly external links) among 24 departmental websites. This diagram exhibits that the website, DoPE (https://dpe.gov.in) is connected with a large number of departmental websites. It is linked with DoC, LD, DoIPAM, DoE, DoEA and DoPT. DoE (https://doe.gov.in/) is linked with four websites i.e. DoEA, DoFS, DoIPAM and DoR. Consequently, a joint initiative among central government departmental websites of India attracts users to search and retrieve more information according to their demand.

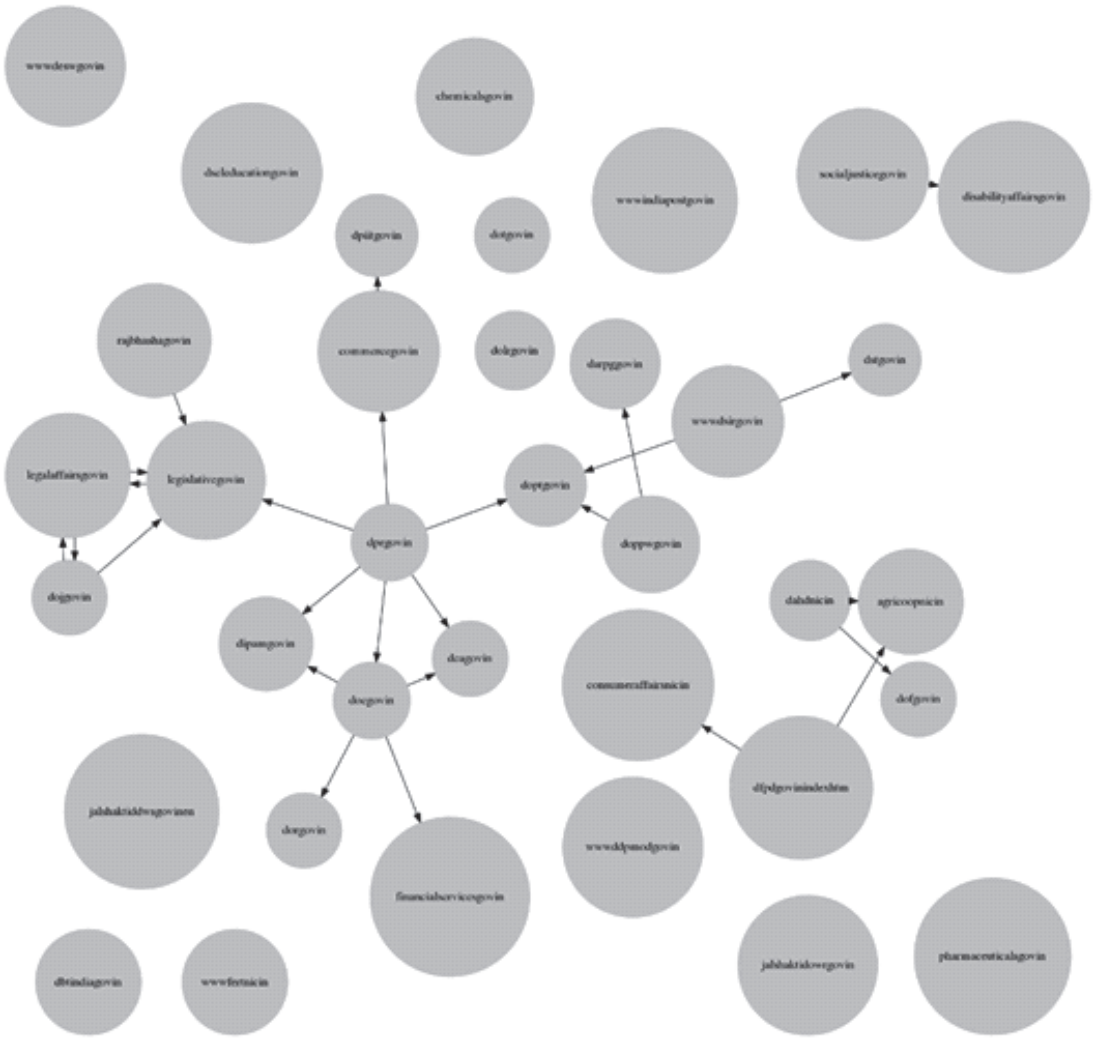

Figure 1: Mapping of departmental websites (GraphViz)

8. Discussion

The study presents several significant findings regarding the web presence and connectivity of Indian central government ministry websites. It highlights the dominance of the gov.in extension, with a mere 10.53% utilising the nic.in domain extension. Notably, the Department of Food and Public Distribution (DoFPD) emerges prominently, securing top ranks across various metrics, including link pages, self-linked web pages, and Domain Authority score. Additionally, the Department of School Education and Literacy (DoSEL) achieves the highest Domain Authority score, while the Department of Agriculture, Cooperation & Farmers Welfare (DoAFW) and the Department of Personnel & Training (DoP) excel in Page Authority and Google Page Rank. Furthermore, the network diagram

underscores the interconnectedness of certain websites, with the Department of Public Enterprises (DoPE) serving as a central hub, linked to multiple departmental websites, facilitating information exchange and collaboration within the government ecosystem. However, the findings also raise questions regarding the disparity in web presence and connectivity among different departments, suggesting areas for improvement in enhancing online visibility and interdepartmental collaboration.

9. Suggestions

- To make the concerned websites searchable via search engines, basic search engine optimisation (SEO) principles of big search engines should be adhered to;
- There shouldn't be any broken links on the departmental websites;
- To make it simpler for users to obtain the information supplied by departments, departmental websites with fewer webpages must improve the number of webpages indexed by search engines.
- So that search engines may quickly access and index the most recent content posted to the websites, the web design and links between the pages need to be corrected.

10. Conclusion

In this study, websites for ministries' departments in India have been evaluated and ranked according to their WIFs (Simple, External and Internal). The website of DoFPD has the highest impact factor based on three selected WIFs i.e. Simple, External and Internal. The chosen websites have been also listed depending on their ranks identified by the tool Google Page Rank. The goal of this study is to provide accurate information on the websites of central government departments of India. It displays the visibility, effectiveness, and link quality of the concerned departmental websites. The results of this study will aid in the diagnosis of the issue and point us in the appropriate path for future study in the area of webometric evaluation.

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Awareness and Satisfaction of Users towards RFID based Circulation System: a study

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Abstract

Radio Frequency Identification (RFID) technology has entirely transformed library management systems, providing effective and automated solutions for various operations-related activities. RFID technology has allowed libraries to increase security and enable high-speed inventory management by automating material handling, lowering data input errors, optimising customer service, and updating records more efficiently. As the use of RFID systems becomes prevalent, understanding user awareness and satisfaction has become crucial for libraries. This work attempts to understand the aspects of using Library circulation services in an RFID environment. The findings reveal that a considerable number of users are familiar with these technologies and their advantages while using the library circulation services. Nevertheless, there are still individuals who are hesitant to utilise services because they are not familiar with this technology. The findings also unveiled the need to organise training and user engagement programmes while implementing technology-assisted services, which is crucial in shaping user satisfaction and awareness.

Keywords: Library circulation, Library users, RFID technology, User awareness, User satisfaction

1. Introduction

Radio Frequency Identification Technology (RFID) technology has been utilised in libraries since the late 1990s, superseding barcode technology for identifying, managing, and tracking library resources and services. Its speed, accuracy, ability to handle large volumes of items, and integration with automated systems make it the favoured option for libraries seeking to increase efficiency, user experience, and circulation operations. The low cost of tags and ease of integrating RFID into the library management system make the library users and staff's tasks easy, smart, and convenient. Furthermore, self-service Kiosk and mobile apps integrated with RFID functionality have revolutionised the way library users interact with library services, enabling seamless and contactless interactions and accessibility of real-time data and information in the workplace and enabling users to perform circulation tasks independently, such as check-in, check-out, and renewing items quickly and easily (Kwok et al., 2008). The self-service feature improves convenience, reduces wait times at the circulation desk, empowers patrons to manage their library accounts autonomously, and decreases library staff reliance (Konoru, 2004). RFID systems

have reduced the staff required at the circulation desk, freeing them to provide more user-centric services (Singh and Mahajan, 2017). RFID systems in library circulation systems improve user experience by simplifying tasks, refining inventory control, and enhancing security measures, allowing staff to focus on engaging projects instead of scanning barcodes.

Doon University: library

Doon University was established by the Government of Uttarakhand by the Doon University Act of 2005, and the University Central Library was established in 2009. Within a decade, its circulation services transformed from using the Browne method to proprietary Libsys LMS software to open-source Koha, and finally to integrating RFID technology for all housekeeping and other activities. The library has implemented RFID technology such as self-checkout (Kiosk), RFID reader staff stations, smart card printers, smart cards for library membership, and a security gate for its services. However, to gain valuable insights into user experience for continuous improvement to ensure user satisfaction and enhance patron engagement, libraries must identify development opportunities and address users' issues and challenges.

2. Review of related literature

Tseng and Kuo (2009) opined that user apprehension and unfamiliarity are the main challenges in operating an automated library system despite its ability to meet the needs of technologically savvy patrons. Ward and Kranenburg (2006) noted that identifying and tracking book movement is one of libraries' most prevalent applications of RFID technology. Curran and Porter (2007) reported that RFID enhances customer book search and identification. Selamat and Majlis (2006) stated that self-issuing stations had reduced the number of staff required at the circulation counter to a minimum. Shahid (2005) emphasised that RFID speeds up library materials' borrowing and return procedures, freeing up staff to design and deliver more productive and value-added library services to users. Yenurkar and others (2017) and Madhusudan and Gupta (2014) suggested that an RFID-based library management system can facilitate fast transactions, reduce manual bookkeeping, and enhance traceability and security by eliminating manual intervention. Rahman and Islam (2019) advocated RFID to reduce staff stress, increase efficiency, track and locate items quickly, book drop support at any time, facilitate seamless circulation, promote self-check-in check-out activities, etc. Hasanand Saini (2017) asserted that implementing RFID in libraries allows users to use the circulation system 24/7. Kern (2004) acknowledged that self-checking and user satisfaction are two advantages of library RFID systems. Coyle (2005) stated that implementing RFID enhanced user satisfaction and reduced the average time for checking in and out of library books (Singh et al., 2006). Khanna (2014) demonstrated the positive effects of RFID on the circulation process, enhanced security measures, and efficient inventory management. Ahmed (2018) found that most users are satisfied with RFID systems after their implementation in libraries and that the transaction rate of library resources has increased. Kaur and Malhotra (2018) stated that kiosks have become an alternative to circulation/information services and have made services available beyond the library's physical boundaries.

Overall, the literature suggests that RFID technology has several potential benefits for libraries, including improved efficiency, security, and user satisfaction. However, more research is needed to understand user perceptions of RFID systems better and identify potential challenges or drawbacks.

3. Objectives of the study

i. To assess users' awareness of implementing RFID technology in the library

ii. To determine users' understanding of the different components of the RFID system

iii. To investigate the purposes of using RFID in the library

iv. To check the efficiency of library circulation services after implementing the RFID system

v. To identify the benefits and problems experienced by users in using RFID systems

vi. To measure users' satisfaction with the existing RFID technology.

4. Methodology

This study investigated the awareness and satisfaction of users towards the applications of RFID technology in library circulation services. The survey method was used to collect data from undergraduate and postgraduate students, research scholars, faculty, and the central library of Doon University staff. A structured questionnaire containing open and closed-ended questions was circulated to 200 university users. Out of these, 181 filled questionnaires were returned. The response rate was 90.5%. The collected data was analysed using percentage analysis.

5. Analysis and interpretation

5.1 *Awareness of RFID applications in circulation services*

The library's user status is determined by their understanding of new technology, such as the RFID-assisted circulation system, which respondents were asked to confirm. It is evident that 56.4% of the users are well aware of the new technology implemented in the library, while 10.5% of users are somewhat aware that this system is being used in the library, and 21% of users are not aware, and 12.2% users have only heard about this technology. A sizable portion of library patrons still need to be acquainted with the RFID-assisted circulation service despite the library's attempts to promote their library orientation programmes.

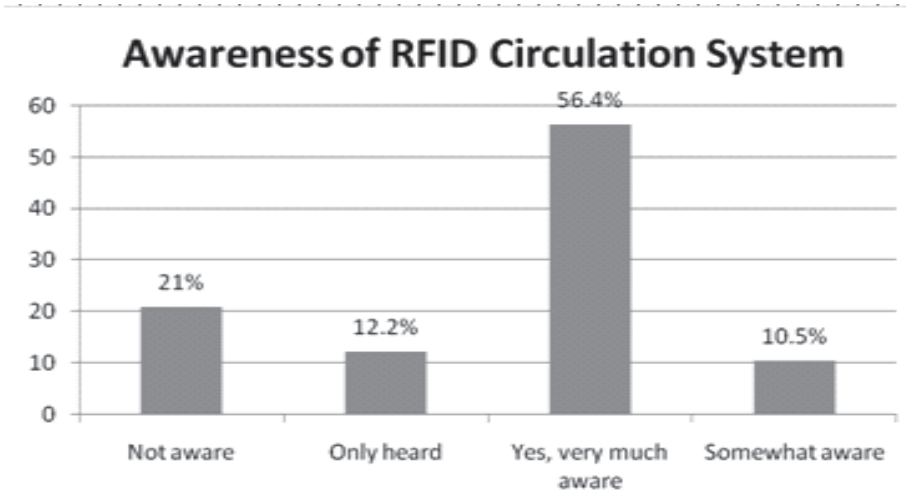

Figure 1: Awareness of RFID applications

5.2 *Awareness of RFID components in the library circulation services*

RFID-assisted library circulation improves services by automating material handling, reducing data entry errors, enhancing customer service, and updating records more efficiently. In response to the query regarding awareness of the users of the various RFID components, the results indicate that many users know of RFID smart cards, RFID tags, RFID scanners and readers, self-service (Kiosk), and security gates.

Table 1: Awareness of RFID components

S.N.	Opinion	Response
1	RFID tag	147(81.2%)
2	RFID smart card	167(92.3%)
3	RFID scanner reader	138(76.2%)
4	Self-service (Kiosk)	141(77.9%)
5	Security gate	139(76.8%)

(Note: *Multiple answers are permitted)

5.3 *Use of self-service (Kiosk) in the Library by patrons*

RFID-enabled self-service kiosk minimises library personnel's workload; improve inventory management accuracy and user experience independently without staff intervention, reduce waiting times and allow the staff to add value to other services. They also save the library and its patron's time and money.

Table 2: Use of self-service (Kiosk)

S.N.	Opinion	Response
1	Check-in/check-out of books	111(61.3%)
2	Book details	22(12.2%)
3	Reservation of books	18(9.94%)
4	Patrons details	17(9.39%)
5	Purchase suggestions	13(7.8%)

An attempt was made to look at various uses of RFID integration in the library circulation services by the patrons. Table 2 indicates that 61.3% of users use the Self-service facility (Kiosk) for check-in/check-out of books. While 12.2% of users used this tool to see the book's details, followed by patron details (9.39%). Furthermore, 9.94% of users reveal that they use this technology to reserve books and requisition books and journals (7.8%).

5.4 ***User's preference in check-in/check-out in the library***

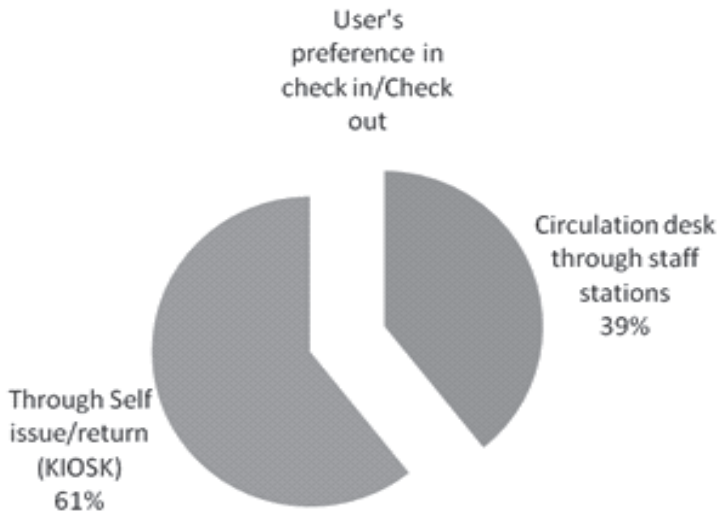

Figure 2: User's preference

Users prefer library self-service kiosks for book issuance/returning, demonstrating the efficient and engaging patron experience achieved through RFID-based circulation, allowing convenient check-in and check-out of materials. Significantly, 39% of patrons are still reluctant and avoid using library self-service, preferring to rely on staff support to check out and return materials. This calls for campaigns emphasising the advantages of utilising library self-service, including quicker transactions, round-the-clock accessibility, and shorter line-ups at circulation counters. Furthermore, the library might provide reluctant consumers with individualised support by manning library staff near kiosks to assist users with the procedure and resolve their concerns.

5.5 ***Reason for preferences***

Open-ended questions were asked to the users to comprehend patrons' preference in opting for the library self-service (Kiosk) instead of the circulation desk. A majority of users prefer the self-issue/return facility for faster and easier transactions, as this facility requires no help from staff other than the circulation desk from the staff stations.

5.6 ***Awareness programme for Library self-service (Kiosk)***

To perceive the awareness of the library self-service (Kiosk) in the library, respondents were asked whether they have been provided orientation about its functioning, and the responses are shown below in figure 3

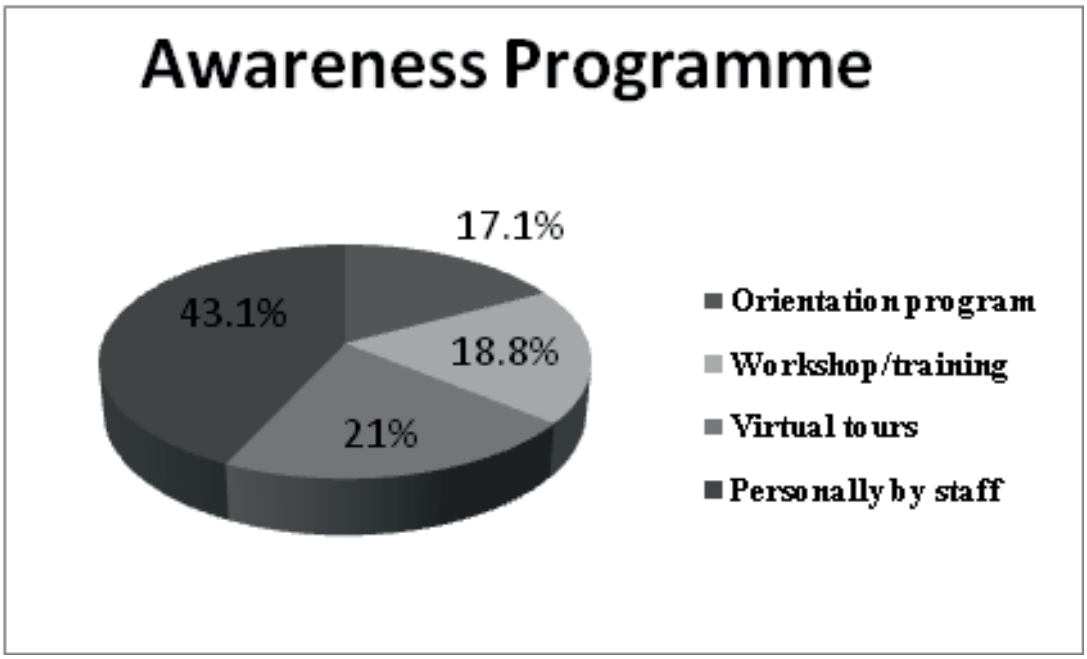

Figure 3: Awareness programme

The survey result described in figure 3 reveals that 43.1% of users get information about the self-issue/return facility through personal interaction with staff. The findings show that staff is actively involved in the awareness programme. 21% of users are aware of this technology through virtual tours. While 17.1% of users responded that they received an orientation programme for using the self-issue/return facility, 18.8% of users revealed that they get training for using this technology from the library. The findings suggest that the library should organise extensive patron orientation and training initiatives. These initiatives will assist users in navigating through the new circulation processes and using technology efficiently.

5.7 *Benefits of using RFID-based circulation services*

RFID technologies enhance efficiency in operation processing, eliminating the need for librarians to scan individual barcodes and allowing simultaneous check-in/out, verification, and entrance guard control (Yu, 2007).

Table 3: Benefits

SN	Opinion	Response
1	Reduce the time of the check-in/check-out process	153(84.5%)
2	Multiple books issued/returned	142(78.5%)
3	No dependency on staff	137(75.7%)
4	Fast transaction	132(72.9%)
5	Online reservation of books	143(79%)
6	User privacy reliable	151(83.4%)
7	Decrease latency	152(84%)

(Note: *Multiple answers are permitted)

The survey findings in table 3 show that a considerable number of respondents agree that RFID-assisted circulation has reduced the time of the check-in/check-out process in comparison to the staff-assisted barcode-based circulation process. The study found that RFID-assisted circulation reduced latency periods and waiting times by eliminating the need for library staff assistance, thereby reducing the overall efficiency of the circulation process.

5.8 *Problems faced by users while using RFID-assisted circulation*

Table 4: Problems faced

SN	Opinion	Response
1	No awareness program	106(58.6%)
2	Security gate collision	5(2.76%)
3	Upgradation of computers	6(3.31%)
4	Lack of assistance from staff	35(19.3%)
5	Slow speed	7(3.87%)
6	Return/issue slip receipt not working	8(4.42%)
7	RFID tag missing/not working	9(4.97%)
8	Book not returned showing in their account	5(2.76%)

Table 4 shows the problems users face when using RFID-based circulation systems. A staggering 58.6% of users revealed that the library organized no awareness programme, while 19.3% responded for lack of assistance from staff. 4.97% of users reveal that sometimes the RFID tag is missing/ not working while issuing books from the library. The other problems users face are return/issue slip receipts not working (4.42%), computer upgrades (3.31%), and slow speeds (3.37%). To ensure maximum utilisation of RFID-based systems, it is important to ascertain the problems they face using this technology. Frequent orientation of users can help levitate the use of RFID systems, thereby ensuring optimum use of library assets (Sahid, 2005).

5.9 Opinion

The implementation of RFID (Radio Frequency Identification) technology has substantially transformed library operations by improving efficiency and security, offering patrons convenience, allowing library staff to showcase the application of the latest technological advancements, and improving

user experience. The users were requested to give feedback and suggestions on how to improve the existing RFID-based circulation system rendered by the library and enhance the library circulation services in the future.

Table 5: Opinion

Opinion	Response				
Effectiveness of the RFID system in speeding up the borrowing process	**Ineffective**	**Effective**	**Moderate**	**Somewhat effective**	**Highly effective**
	0 (0)	1 (.55%)	29 (16.02%)	91(50.28%)	60 (33.15%)
Satisfaction with the self-checkout stations (KIOSK) provided by the RFID system	**Very dissatisfied**	**Dissatisfied**	**Moderate**	**Somewhat satisfied**	**Highly satisfied**
	0 (0)	2 (1.1%)	26 (14.36%)	96 (53.04%)	57 (31.49%)
Overall convenience of using the RFID system compared to previous methods in circulation services	**Much less convenient**	**Convenient**	**Moderate**	**Somewhat convenient**	**Much more convenient**
	0 (0)	1 (.55%)	27 (14.92%)	90 (49.72%)	63 (34.81%)
Overall experience with the RFID-based circulation system		**Poor**	**Moderate**	**Good**	**Excellent**
	0 (0)	0 (0)	25 (13.81%)	95 (52.49%)	61 (33.70%)

The analysis of table 5 reveals that the adoption of Radio-Frequency Identification (RFID) technology in the library has significantly enhanced the borrowing process speed, with 33.15% of users reporting successful borrowing speeds and 50.28% finding it fairly effective. User satisfaction with self-checkout stations is also notable, with 31.49% highly satisfied and 53.04% reasonably satisfied. The data underscores the overall convenience of the RFID system compared to the previous barcode-based method, with 49.72% of users finding it somewhat convenient and 34.81% rating it much more convenient. This indicates an improvement in user experience, likely due to increased efficiency, speed, and user-friendliness. Additionally, users rated their overall experience with RFID-based circulation systems as 52.49% good and 33.70% excellent, demonstrating the system's convenience and time-saving benefits for daily transactions.

6. Discussion

The present study discusses the implementation of RFID technology in library circulation services, highlighting various aspects of its awareness, benefits, challenges, and the importance of user education and feedback. Despite efforts to promote RFID-assisted circulation services, there is a need to raise awareness among library users about its full extent of benefits. RFID-enabled self-service kiosks are preferred to minimise staff workload, improve inventory management, and provide users with a convenient and efficient experience, particularly for book issuance and returns. The study emphasises the significance of extensive patron orientation and training initiatives to help users navigate new circulation processes and utilise RFID technology effectively. RFID technologies are noted for enhancing operational efficiency by eliminating individual barcode scanning, reducing check-in/check-out times, and

improving overall circulation process efficiency. However, challenges in implementation are acknowledged, suggesting the importance of addressing user problems through frequent orientation sessions and inviting user feedback for further system enhancements. Overall, the study's results underscore the comprehensive overview of RFID technology in library circulation services, emphasising the need for increased awareness, user education, and continuous improvement efforts to optimise library RFID system utilisation.

7. Conclusion

The present research conducted on the application of RFID-based circulation system has shed light on how to administer libraries in a more organised, effective, and user-friendly way. It was evident that users and staff take time to get aquatinted at the outset. However, with frequent usage, RFID technology will become an invaluable tool for library management, providing several benefits like automated inventory control, expedited checkout and circulation processes, increased security, and improved patron pleasure. It is relevant to note that implementing an RFID library management system would necessitate careful planning, funding, employee training, and continuous maintenance. The case study's conclusions will assist other libraries planning to introduce RFID-based circulation in identifying specific RFID circulation system components and effectively addressing common challenges users and staff face.

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From Bytes to Bushlands: illuminating Australia and New Zealand's natural treasures through open government data (OGD) initiatives

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Abstract

In the era of digitalisation, where data is a catalyst for innovation and information accessibility extends beyond numbers, transparency now encompasses the natural world's essence. Australia and New Zealand, renowned for their breathtaking landscapes and rich biodiversity, have embarked on a transformative journey of sharing their environmental treasures with the world through Open Government Data (OGD) initiatives. This article explores how OGD initiatives in Australia and New Zealand illuminate the bushlands, mountains, coastlines, and unique ecosystems, fostering a deeper connection between people and the environment. It delves into the significance of leveraging OGD to address environmental challenges, including climate change and biodiversity loss, while highlighting the impact of OGD on promoting transparency, accountability, and public engagement in conservation efforts. Through a comprehensive methodology encompassing literature review, data collection, analysis, GIS mapping, and thematic analysis, this study assesses the effectiveness of OGD initiatives and identifies key challenges, opportunities, and best practices. The findings underscore the importance of OGD in advancing environmental stewardship, scientific discovery, and public engagement in the 21st century. In conclusion, the article advocates for continued innovation and collaboration to maximise the societal benefits of OGD, driving positive outcomes for current and future generations.

Keywords: Australia, Biodiversity, Environmental data, Environmental monitoring, Geographic Information System (GIS), Indigenous cultures, Natural treasures, New Zealand, Open government data (OGD), Sustainable development goals (SDGs)

1. Introduction

In the digital age, where information is at our fingertips and data fuels innovation, the concept of transparency and accessibility has extended beyond just numbers and statistics. Now, it encompasses the very essence of our natural world. Australia and New Zealand, known for their breathtaking landscapes and rich biodiversity, have embarked on a transformative journey of sharing their environmental treasures with the world through Open Government Data (OGD) initiatives. These initiatives embrace the principles of open access (Biswas, Brar, & Bhabal, 2022) ensuring that valuable environmental data is readily available to all. In this era of interconnectedness, where global citizens seek to understand and appreciate the wonders of nature, the utilisation of OGD has emerged as a powerful tool for illuminating the bushlands, mountains, coastlines, and unique ecosystems that define these nations. This article delves into how OGD initiatives in Australia and

New Zealand are not only opening doors to data but also unlocking the beauty and significance of their natural landscapes, fostering a deeper connection between people and the environment. Through the lens of data transparency, we embark on a journey from bytes to bushlands, exploring the intersection of technology, conservation, and appreciation for the natural world.

2. Literature review

In recent years, the convergence of technology and environmental conservation has led to the emergence of Open Government Data (OGD) initiatives (Biswas & Chakraborty, 2022; Biswas, 2022) aimed at shedding light on the natural wonders of countries such as Australia and New Zealand. This literature review examines the scholarly discourse surrounding the utilisation of OGD to illuminate the rich biodiversity and stunning landscapes of these nations.

One seminal work in this field is the study by Kitchin and McArdle (2016), who provided a comprehensive overview of OGD initiatives worldwide and their potential applications in environmental research and conservation efforts. Furthermore, research by Huijboom and Van den Broek (2011) underscored the significance of OGD in promoting citizen participation and collaboration in environmental monitoring and management. Through case studies from various countries, including Australia and New Zealand, they demonstrated how OGD platforms can empower citizens to contribute to biodiversity monitoring, ecosystem management, and sustainable development initiatives. In the context of Australia, studies such as those by Mendes and Wallace (2018) and Gault et al. (2020) explored the potential of OGD to enhance understanding of the country's unique ecosystems and biodiversity hotspots.

Similarly, research focusing on New Zealand, such as the work by Wilson et al. (2019) and Singh et al. (2021), examined the impact of OGD initiatives on conservation efforts and natural resource management. These studies emphasised the importance of data interoperability, standardisation, and quality assurance in ensuring the effectiveness of OGD platforms for environmental monitoring and reporting.

Despite the progress made in leveraging OGD to illuminate Australia and New Zealand's natural treasures, several challenges and opportunities remain. For instance, issues related to data privacy, security, and governance require careful consideration to balance transparency with the protection of sensitive environmental information (Chin et al., 2018). Additionally, there is a need for ongoing investment in digital infrastructure, capacity building, and stakeholder engagement to maximise the impact of OGD initiatives on environmental sustainability (UNDP, 2020).

3. Significance of the study

This study remains highly relevant in the present context for several reasons. Firstly, with the increasing urgency of addressing environmental challenges such as climate change, biodiversity loss, and habitat degradation, there is a growing demand for accessible and reliable environmental data to inform evidence-based decision-making and public awareness campaigns (IPCC, 2021). Secondly, the COVID-19 pandemic has underscored the importance of digital technologies and remote collaboration in supporting environmental monitoring and conservation efforts, making OGD initiatives more essential than ever before (Bennett et al., 2020). Lastly, as countries strive to achieve the Sustainable Development Goals (SDGs) set forth by the United Nations, including those related to environmental sustainability and biodiversity conservation, OGD can serve as a valuable tool for tracking progress,

monitoring indicators, and promoting accountability at the national and global levels (UN, 2020). Finally, the topic of leveraging OGD to illuminate Australia and New Zealand's natural treasures holds immense significance in the contemporary context, offering insights into how technology and data-driven approaches can contribute to environmental stewardship, scientific discovery, and public engagement in the 21st century.

4. Objectives

The objectives of the study are:

I. To assess the current status and effectiveness of Open Government Data (OGD) initiatives in Australia and New Zealand in providing access to environmental data related to their natural landscapes and biodiversity

ii. To investigate the impact of OGD initiatives on promoting transparency, accountability, and public engagement in environmental conservation and management efforts

iii. To identify key challenges, opportunities, and best practices associated with leveraging OGD to illuminate the natural treasures of Australia and New Zealand, including issues related to data quality, interoperability, privacy, and governance

iv. To provide recommendations for enhancing the effectiveness and accessibility of OGD initiatives in Australia and New Zealand, as well as strategies for overcoming barriers and maximising the societal benefits of open environmental data for both countries.

5. Methodology

Literature review: For this study a comprehensive review of existing literature, research papers, reports, and governmental documents related to Open Government Data (OGD) initiatives, environmental conservation efforts, and biodiversity data management in Australia and New Zealandwas conducted.

Data collection: Quantitative and qualitative data were gathered related to OGD initiatives, environmental datasets, and conservation efforts from relevant government agencies, non-governmental organisations, research institutions, and other authoritative sources in Australia and New Zealand. Official databases, websites, and reports were also utilised to collect information on the availability, accessibility, and scope of environmental datasets.

Data analysis: Collected data were analysed to assess the current status and effectiveness of OGD initiatives in Australia and New Zealand. Statistical methods were utilised to quantify the availability and coverage of environmental datasets, including natural landscapes, biodiversity, indigenous cultures, and environmental conservation.

GIS mapping: Geographic Information System (GIS) tools were utilised to visualise and map the spatial distribution of environmental datasets, including natural landscapes, biodiversity hotspots, protected areas, and environmental monitoring sites in Australia and New Zealand.

Thematic analysis: Thematic analysis techniques were employed to categorise and interpret the findings according to key themes such as data accessibility, quality, interoperability, privacy concerns, governance issues, and societal impacts. It has been done to identify patterns, trends, and correlations within the data to draw meaningful conclusions.

6. Findings

The different segments related to natural treasures found on OGD portals of Australia and New Zealand are presented in table 1.

Table 1: Data sets related to natural treasures found on OGD portals of Australia and New Zealand

Category	Australia	New Zealand
	Dataset	Dataset
Natural Landscapes	854	108
Biodiversity	2875	927
Indigenous Cultures	65	23
Environmental Conservation	737	997

Table 1 shows the different segments related to natural treasures found on OGD portals of Australia and New Zealand along with datasets. It is found Australia has the highest number of data except data on environmental conservation in comparison with datasets of New Zealand.

6.1 *Natural landscape*

Table 2: Different segments related to natural landscape found on OGD portals of Australia and New Zealand

Category	Australia	New Zealand
	Dataset	Dataset
GIS/ Topographic Data	132	22
Land use and land cover data	588	74
Water resources data	53	07
Protected areas data	81	05
	854	**108**

Table 2 presents the different segments under the natural landscape. These are:

i. ***Geographic Information System (GIS)/topographic data:*** This includes digital elevation models (DEM), contour maps, satellite imagery, and other spatial data related to natural landscapes such as land cover, vegetation types, terrain, and geological features in Australia and New Zealand. It is found that Australia and New Zealand so far uploaded 132 and 22 datasets respectively.

ii. ***Land use and land cover data:*** Data on how land is being used and the types of vegetation or land cover present in different areas of Australia and New Zealand has been presented. This includes information on forests, grasslands, agricultural land, urban areas, etc. Australia is in the leading position by uploading 588 datasets followed by New Zealand with 74 datasets. This is valuable for land

management and planning purposes.

iii. ***Water resources data:*** Information about rivers, lakes, wetlands, and other water bodies in Australia and New Zealand, including water quality, flow rates, and hydrological features have been provided. Though New Zealand has uploaded only 7 datasets Australia is in a little better position by uploading 53 datasets.

iv. ***Protected areas data:*** Information about national parks, conservation reserves, and other protected areas in Australia and New Zealand have been given. This includes boundaries, management plans, and ecological values of these areas. Australia has so far uploaded 81 datasets. At the same time, New Zealand has uploaded only 5 datasets in this regard.

6.2 *Biodiversity*

Table 3: Diverse aspects concerning biodiversity found on OGD portals of Australia and New Zealand

Category	Australia	New Zealand
	Dataset	**Dataset**
Species Distributions	1347	674
Threatened Species	475	38
Ecosystem Classification	266	164
Invasive Species	83	08
Genetic Resources	158	12
Citizen Science	546	31
	2875	**927**

Table 3 presents the different segments under biodiversity. These are:

i. ***Species distributions:*** Datasets containing information about the distribution of various plant and animal species across Australia and New Zealand have been connected. These datasets include species occurrence records, species richness maps, and species distribution models derived from field surveys, citizen science initiatives, and other data sources. It is found that a good number of datasets, i.e., 1347 have been incorporated into OGD portal of Australia. New Zealand's figure is also not bad, i.e., 927 in terms of total datasets, i.e., 927.

ii. ***Threatened species:*** Information about species that are classified as threatened or endangered according to national and international conservation assessments has been included. This includes lists of threatened species, their status assessments, recovery plans, and monitoring data aimed at tracking population trends and conservation efforts. Australia has reflected growing concerns by uploading 475 datasets and New Zealand has uploaded so far 38 datasets.

iii. ***Ecosystem classification:*** Information about different ecosystem types and classifications used to categorise Australia's and New Zealand's diverse landscapes and habitats are available. This includes vegetation classifications, ecosystem mapping products, and spatial datasets describing the distribution and composition of different ecosystem types. Both countries have uploaded 266 and 164 datasets respectively.

iv. ***Invasive species:*** Australia's OGD portal offers a more extensive collection, with 83 datasets related to natural treasures, focusing on invasive species' distribution, spread, impacts, and management efforts. Similarly, New Zealand's OGD portal provides 8 datasets which also encompass information about invasive species and their management. These datasets serve as crucial resources for understanding and mitigating the threats posed by invasive species, facilitating informed decision-making and conservation actions in both countries.

v. ***Genetic resources:*** Australia is ranked as having a more substantial collection of genetic resources data on its Open Government Data (OGD) portal compared to New Zealand, with 158 datasets dedicated to genetic resources. These datasets likely encompass data on the genetic diversity of plant and animal species, including genetic sequencing data, DNA bar-coding records, and information about genetic variation within and among populations. On the other hand, New Zealand's OGD portal offers a more limited selection, with only 12 datasets focusing on genetic resources.

vi. ***Citizen Science:*** Australia demonstrates a more extensive collection, with 546 datasets dedicated to citizen science. These datasets likely encompass a wide range of biodiversity monitoring, species recording, and environmental observation initiatives that engage volunteers. Whereas, New Zealand's OGD portal offers a more limited selection, with only 31 datasets focusing on citizen science.

6.3 *Cultural heritage data*

From the available datasets from table 1, related to indigenous cultures on the Open Government Data (OGD) portals of Australia and New Zealand, both countries demonstrate a commitment to showcasing culturally significant sites within their natural landscapes. Australia's OGD portal provides 65 datasets dedicated to indigenous cultures, offering information about indigenous heritage sites, archaeological sites, and historic landmarks. For instance, Australia offers details about Uluru-Kata Tjuta National Park, which holds immense cultural significance for the Anangu people, the traditional owners of the land. Additionally, Australia provides information about Kakadu National Park, a UNESCO World Heritage Site containing numerous indigenous heritage sites, including rock art galleries, burial sites, and ceremonial grounds, offering insights into indigenous culture and traditions. On the other hand, New Zealand's OGD portal offers 23 datasets related to indigenous cultures, highlighting sites such as Whakarewarewa Geothermal Valley (Rotorua). This living

Maori village is located within a geothermal valley near Rotorua and is home to the Tahourangi/Ngati Wahiao people, who have lived in the area for centuries. Visitors to Whakarewarewa can experience traditional Maori culture, including geothermal cooking, weaving, and cultural performances. While both countries provide valuable information about indigenous cultures, Australia's OGD portal offers a slightly higher number of datasets, reflecting the diverse range of culturally significant sites within the country's natural landscapes.

6.4 *Environmental conservation*

Table 4: Various facets pertaining to environmental conservation found on OGD portals of Australia and New Zealand

Category	Australia	New Zealand
	Dataset	**Dataset**
Environmental Monitoring	162	181
Natural Resource Management	264	412
Climate Change and Adaptation	202	313
Environmental Policies and Regulations	52	77
Education and Outreach	57	14
	737	**997**

Table 4 presents various facets pertaining to environmental conservation. These are:

i. ***Environmental monitoring:*** Australia's OGD portal offers 162 datasets dedicated to environmental monitoring, encompassing information about air quality, water quality, soil health, and climate indicators. Similarly, New Zealand's OGD portal provides 181 datasets related to environmental monitoring, indicating a comprehensive effort to monitor and assess environmental conditions.

ii. ***Natural resource management:*** Australia and New Zealand demonstrate a concerted effort to promote sustainable practices and conservation of their natural resources on their respective OGD portal. Australia's OGD portal provides 264 datasets dedicated to natural resource management, encompassing various aspects such as forests, water resources, fisheries, and agricultural lands. Similarly, New Zealand's OGD portal offers a more extensive collection, with 412 datasets related to natural resource management, indicating a comprehensive approach to managing and conserving its natural resources.

iii. ***Climate change and adaptation:*** Australia and New Zealand reveal a proactive approach towards addressing the challenges posed by climate change. Australia's OGD portal provides 202 datasets dedicated to climate change and adaptation, encompassing a range of information including climate change impacts, vulnerability assessments, adaptation strategies,

and greenhouse gas emissions. Similarly, New Zealand's OGD portal offers 313 datasets related to climate change and adaptation, indicating a comprehensive approach to addressing climate change challenges.

iv. ***Environmental policies and regulations:*** Australia's OGD portal provides 52 datasets dedicated to environmental policies and regulations, encompassing a range of information including environmental laws, regulations, permits, compliance records, and enforcement actions. Similarly, New Zealand's OGD portal offers 77 datasets related to environmental policies and regulations, indicating a comprehensive approach to environmental governance.

v. ***Education and outreach:*** Australia and New Zealand aim to promote environmental education and public awareness, albeit with varying degrees of emphasis. Australia's OGD portal provides 57 datasets dedicated to education and outreach, offering resources such as environmental education programmes, public awareness campaigns, and educational materials for schools and communities. Conversely, New Zealand's OGD portal offers a more limited selection, with only 14 datasets related to education and outreach. Despite the difference in numbers, both countries recognise the importance of environmental education in fostering informed decision-making and promoting sustainable behaviours among citizens.

6.5 *Format of datasets*

Table 5 : Formats of datasets pertaining to different segments of natural treasures

	Natural Landscapes		Biodiversity		Indigenous Cultures		Environmental Conservation	
Formats	**Aus**	**NZ**	**AUS**	**NZ**	**AUS**	**NZ**	**AUS**	**NZ**
AAIGrid	-	01	-	02	-			356
ArcGIS Geoservice REST API	-	65	-	657	-	09		37
bash		-		01	-	-		-
CSV	55	89	311	804	15	22	47	549
DOCX		-		01	-	-	-	1
DPKG	-	02	-	-	-	-	-	-
DWG	-	02	-	75	-	-		195
ESRI MAPSERVER	97	-	233	-	5	-	87	-
Esri REST	-	26	-	47	-	01	-	15
FNA		-		-	-	-	-	01
File GDB		-		02	-	-		-
GEOJSON	53	85	138	693	12	10	54	47
Geoservice api	-	04	-	03	-	-	-	-
GPKG		-		100	-	12	-	487
GTiff	-	01	-	10	-	-	-	409

	Natural Landscapes		Biodiversity		Indigenous Cultures		Environmental Conservation	
Formats	**Aus**	**NZ**	**AUS**	**NZ**	**AUS**	**NZ**	**AUS**	**NZ**
HFA		-		08	-	-	-	53
HTML	219	92	1144	713	26	11	258	54
JSON		-		-	6	-	-	
JPEG		-	120	20	-	-	-	53
JP2		-		08	-	-	-	52
JP2_ LOSSLESS		-		08	-	-	-	52
KEA	-	01	-	10	-	-	-	409
KML	-	87	-	768	7	10	-	240
MapInfo File	-	02	-	100	-	12	-	487
MapInfo MIF	-	02	-	98	-	12	-	487
OGS WFS	-	03	-	01	-	-	-	2
OGS WMS	-	03	-	03	-	-	-	3
OpenFile GDB	-	02	-	98	-	12	-	487
PDF	266	03	552	95	14	-	178	559
PNG	-	-		18	-	-	-	3
py	-	-		01	-	-	-	1
QUAL	-	-		-	-	-	-	1
r	-	-		-	-	-	-	1
R	-	-		05	-	-	-	2
raster	-	01	-	-	-	-	-	
Rdata	-	-		01	-	-	-	1
SHP	59	02	133	102	12	12	40	487
SPATIAL	69	-	-	-	-	-	-	-
TIFF	-	-		01	-	-	-	-
tre	-	-		01	-	-	-	-
TSV	-	-		06	-	-	-	3
TXT	-	-		06	-	-	-	5
WEB	57	-	-	-	-	-	60	-
WFS	-	-	130	-	-	-	40	-
WMS	76	-	281	-	6	-	68	-
XLS	-	-		03	-	-	-	4
XLSM	-	-		-	-	-	-	1
XLSX	-	-		09	12	-	-	11
ZIP	270	86	574	702	-	10	151	53
.csv	-	-		-	-	-	-	2
.zip	-	-		01	-	-	-	2
	1221	**559**	**3616**	**5181**	**115**	**133**	**983**	**5612**

(*AUS= Australia and *NZ = New Zealand)

The availability of datasets presented in table 5 in different formats plays a crucial role in enhancing the accessibility and usability of data related to natural landscapes, biodiversity, indigenous cultures, and environmental conservation on the Open Government Data (OGD) portals of Australia and New Zealand. By providing data in various formats such as CSV, GeoJSON, KML, SHP, TIFF, XLS, and ZIP, these portals

cater to a wide range of users with different technical preferences and requirements. For example, CSV and XLS formats are widely used for tabular data, making it easy for users to analyse and manipulate datasets related to biodiversity monitoring or environmental assessments. GeoJSON, KML, and SHP formats are ideal for spatial data, allowing users to visualise and analyse geographic information about natural landscapes, indigenous cultural sites, and protected areas. Additionally, formats such as PDF and DOCX may be used for documents, reports, or educational materials, enhancing the dissemination of information about environmental conservation initiatives or indigenous cultural heritage. The availability of datasets in multiple formats ensures that stakeholders, including researchers, policymakers, educators, and the general public, can access and utilise the data in their preferred tools and platforms, thereby fostering greater transparency, collaboration, and engagement in efforts to protect and preserve the natural and cultural heritage of Australia and New Zealand.

6.6 *Additional structural analysis of OGD portals of Australia and New Zealand*

6.6.1 *Australia's OGD*

Australia's OGD portal appears to have a robust structure, offering essential metadata, updated information, tags, and APIs for interoperability. The inclusion of organisation names contributing data enhances transparency and accountability. The National Map service, providing geospatial data, is a significant asset, enabling users to visualise and analyse spatial information effectively. However, despite these strengths, there are notable challenges and opportunities:

Challenges:

Some challenges are still there like data quality, interoperability, privacy and governance.

Opportunities:

The availability of geospatial data through the National Map service presents opportunities for innovation in various sectors. Users can access a wide range of geospatial datasets, including topographic information, land use and land cover data, water resources data, and protected areas data. For instance, the availability of detailed GIS/topographic data enables researchers, policymakers, and conservationists to accurately map and analyse the diverse landscapes of Australia, ranging from dense forests to arid deserts, thereby facilitating informed decision-making regarding land use planning, biodiversity conservation, and natural resource management. Besides that, collaboration and public engagement play a crucial role in promoting transparency and accountability.

Best practices:

Providing clear metadata and attribution of data sources enhances transparency and trust in the OGD portal along with user-centric design and community engagement.

6.6.2 *New Zealand's OGD*

New Zealand's OGD portal demonstrates several innovative features, such as grouping datasets into specific categories for easier discovery and a cataloguing guide system. Additionally, the integration of a blog feature and social media connectivity enhances citizen engagement and feedback mechanisms. However, there are challenges and opportunities to consider:

Challenges:

There are still some challenges related to data grouping and cataloguing, data quality, privacy and security and governance.

Opportunities:

The grouping of datasets and cataloguing guide system offer opportunities for users to discover relevant data more efficiently, fostering greater use and uptake of OGD along with citizen engagement through social media and blogging features and data-driven decision making.

Best practices:

User feedback mechanisms: Encouraging and actively soliciting feedback from users via social media, blogs, and other channels can help identify areas for improvement and prioritize future developments along with ensuring accessibility. Establishing a robust data governance framework that addresses issues of quality, privacy, security, and accountability is also fundamental to the long-term success and sustainability of the OGD initiative.

Needless to say, both Australia and New Zealand have made significant strides in leveraging OGD to illuminate their natural treasures, yet they face common challenges such as ensuring data quality, privacy protection, and effective governance. By embracing best practices and seizing opportunities for innovation and collaboration, these countries can further harness the power of OGD to drive positive social, economic, and environmental outcomes.

7. Conclusion

In conclusion, the transformative journey undertaken by Australia and New Zealand through Open Government Data (OGD) initiatives has illuminated their natural treasures, fostering transparency, accountability, and public engagement in environmental conservation and management efforts. By leveraging OGD, these nations have not only provided access to vital environmental data but have also unlocked the beauty and significance of their landscapes, biodiversity, indigenous cultures, and conservation initiatives. Despite facing challenges such as data quality assurance, privacy concerns, and governance issues, both countries have demonstrated a commitment to innovation, collaboration, and stakeholder engagement. Moving forward, embracing best practices and seizing opportunities for continued improvement will be paramount in maximising the societal benefits of OGD, driving positive environmental, social, and economic outcomes for current and future generations in Australia, New Zealand, and beyond.

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Information Seeking through Information Communication Media from the Olden Days to Internet Dominated Era : a theoretical approach

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Abstract

The study investigates the evolution of information seeking practices across different communication media from ancient times to the internet-dominated era. It explores the cognitive process of information need, which varies across individuals, locations, and contexts. Beginning with prehistoric verbal communication and cave paintings, the study traces the development of communication through symbols, letters, telegraph, telephone, and eventually the internet and World Wide Web (WWW). Utilising theoretical frameworks, the research delves into the concept of information seeking, elucidating its role in changing knowledge states and problem-solving. Notably, it examines the significance of signs and symbols in communication, analysing their evolution and impact on information dissemination. Through a comprehensive literature review and theoretical analysis, the study uncovers insights into the modes, types, materials, and reflections of information through various communication media. Findings highlight the continuity in communication patterns despite technological advancements, emphasising the fundamental nature of human information-seeking behaviour. The study concludes that while contemporary communication mediums offer unprecedented connectivity and convenience, they are built upon age-old communication principles, suggesting a timeless pattern in information-seeking behaviour.

Keywords: Information communication, Internet-dominated era, Information seeking Olden days, Prehistoric period

1. Introduction

Need for Information is a cognitive process that differs from person to person, place to place and situation to situation. The necessity of Information is for all the time. This time ranges from prehistoric times to the present time of the Internet. Verbal communication was the only means of communication in the prehistoric period, and various gestures and body language were used to meet the need for Information. Signs and symbols were drawn on cave walls and rocks to cater to the required Information. But with the advancement of civilization, everything has changed. Signs and symbols are not exceptions to this changing environment. A later letter, the telegraph, and the telephone were invented to communicate among human beings along with the verbal mode of communication. After the 1960s, it changed drastically with the advent of the internet and Information Communication Technology (ICT). The dependency on ICT is increasing daily in every sphere of human life. Social media like Facebook, Twitter, etc., have almost grasped the present society, especially the screen-glued Gen-Y. The current research deals with the following items:

- Use of media for communication;
- Use of signs and symbols for communication;
- Materials used for communication media and
- Dissemination of information through signs and symbols.

1.1 *Definition analysis*

1.1.1 *Olden days:*

It refers to the prehistoric period that began with the appearance of human beings and ended with the invention of writing. This is the time of our first ancestors. Hunting and gathering were the only means of life at this time. Verbal communication was the only medium of information communication (Goswami, 2013).

1.1.2 *Internet-dominated era:*

It started with the invention of the internet in 1960. It is continuing. At this time, everything is done with the help of ICT. Whole societal development is based on the internet and ICT. Almost everyone has become screen-glued.

1.1.3 *Information seeking:*

The process involved in changing one's (human being's) state of knowledge is called information seeking. It's a kind of high-level learning and problem-solving cognitive process. In this process, users are supposed to acquire new knowledge and skills through various types of information sources and tools (Tubachi, n.d.). According to Wilson (2000), information seeking is defined as 'the purposive seeing for Information as a consequence of a need to satisfy some goal (Tubachi, n.d.). Marchionini (1995) defines information seeking as "a process in which humans purposefully engage to change their state of knowledge and which is closely related to learning and problem solving". Johnson (1997) defined information seeking as "purposive acquisition of information from selected information careers". Particular roles and their related tasks also result in shaping the information seeking behaviour which is in turn affected by factors such as sources, individual characteristics of the user and the environment surrounding the user (Biswas, Chakrabarti, & Das Biswas, 2013).

1.1.4 *Information communication:*

The word 'Communication' is derived from the Latin word 'Communis', which means 'sharing'. Communication explores all methods used by human beings to express or convey thoughts or feelings. When living beings communicate with someone, they establish a certain degree of commonness with the persons they communicate with (IGNOU).

2. Literature review

In recent literature, Barnes (2017) explores the evolving role of symbols in information communication and technology advancement, emphasising their multifaceted functions in various domains such as entertainment, journalism, and branding. Clara and Swasty (2017) highlight the significance of pictograms as efficient visual communication tools, particularly in museum signage, demonstrating their effectiveness in conveying information without reliance on textual elements. Phare, Gu, Williams, and Loughland (2013) delve into the concept of collaborative design and semiotics, underscoring the potential of signs to foster collective intelligence and generate innovative ideas. St.-Pauls (n.d.) discusses the fundamental role of signs and symbols in graphic communication, emphasising their universality across different languages. Additionally, Hazra (Feb. 2020) examines information-seeking patterns from prehistoric to modern times, identifying six fundamental types of information needs and highlighting

the enduring nature of information-seeking behaviour across ages.

3. Significance of the study

The significance of the study lies in its exploration of the evolution of information seeking practices across different communication media from ancient times to the internet-dominated era. By tracing the cognitive process of information need and the role of signs and symbols in communication, the research sheds light on how human beings have sought and disseminated information over time. Through a comprehensive analysis, the study highlights the continuity in communication patterns despite technological advancements, emphasising the enduring nature of human information-seeking behaviour. This insight into historical and contemporary communication modes provides valuable understanding for scholars and practitioners alike, emphasising the timeless pattern in information-seeking behaviour across ages.

4. Objectives

i. To determine the mode of communication media

ii. To ascertain the types of signs and symbols used for communication media from the olden days to the present era

iii. To narrate the materials used for communication media and what it means by various signs and symbols for communication from past to present.

5. Methodology

A format was framed and filled out by the researcher carefully. Inputs were given to the said format related to the use of media for communication, the use of signs and symbols for communication, materials used for communication media, and the reflection of information through signs and symbols. Information regarding the olden days and for the rest of the part of the inquiry was collected through various sources, i.e., from printed books, e-books, webs, journals/ articles and the discussion among distinguished professors from the Department of History, Vivekananda Mahavidyalaya, Burdwan. The acquired information is represented in tabular form and analysed systematically to reach the outcome(s) of the research.

6. Analysis

Media plays a vital role in communication and information dissemination all the time. Different communication media were used at other times for communication. The following table 1 is about the use of media for communication.

Table 1: Use of media for communication

Media	Year of origin	Special Characteristics	Available Information
Cave paintings / Pictography	Started with the appearance of human beings (about 5 million years ago)	Events and ideas are recorded through drawings. The drawings were painted in the colour of fruit juice and berries and coloured minerals.	Information about hunting, fishing, agriculture, Social Structure
Telegram	1850	Telegram for inland communication and Cablegram for foreign communication. It is used for short message sending. The message must be ended within eight words.	All types of urgent Information are available in a concise form.
Letter	1858	Written Messages are sent through personal messengers, private messengers, and letter carriers after Post services start.	All types of Information
Telephone	1876	Conversion of voices into an electronic signal	'Dial-a fact' provides the required Information
Internet	1960	Network of networks. Concisely defined as “Physical network formed of various networks globally connecting countless other devices that form a huge network of systems”	Covers the whole universe
www (world wide web)	1980	“Global network of computers” or Collection of websites and web pages stored in web servers and connected through the Internet.	Covers the whole universe

Cave paintings / Pictography: Here, ideas are transmitted through drawings (Prehistoric, n.d.)

Telegram: Electrical signal converted into writing on paper and delivered to the recipient (wiki, n.d.)

Letter: "a written, typed, or printed communication, sent in an envelope by post or messenger" (Google, n.d.)

Telephone: Human voices are converted into electronic signals and transmitted via cable between two persons (wiki, n.d.)

Internet: It is the interconnection of computer networks using TCP/IP protocol

www: world wide web (wiki, n.d.)

Table 1 reflects the use of communication media at various times, starting from the appearance of human beings on this globe to the invention of www. Cave paintings/photographyis the first medium for communication, followed by telegram, letters, telephone, internet and www. It also reveals the characteristics of individual media and information available for meeting needs depending on a particular available medium.

It is quite impossible to narrate anything without highlighting the use of signs and symbols for communication, tools for writing, means for communication, and message couriers. The following table 2 deals with the above-noted matter.

Table 2: Use of signs and symbols for communication, tools for writing, means for communication and message courier

Particulars	Prehistoric period / Before the invention of writing	After the invention of writing	After the invention of the Telephone, the Internet and www
Signs and symbols	Signal fires, Smoke,Totems, Horns, Drums, Banners, Polished Swords, Mirror-like copper disks, Flashlight, Messengers with verbal messages,	Written communication was already started	Smart signals are used
Tools for writing	The writing was yet to be invented	Eggshells, Clay tablets, Vellum, Parchment, Paper, Type Writer	Keyboard and other digital devices
Means of communication	Speech, Hand gestures, Body Language, Facial Expression	Letter, Telegraph	Text messages, e-mail, chats, video calling, video conferencing
Messenger	there were indications for information dissemination through drawings and paintings	Pigeon, Messengers on foot, Messengers on horseback like Angros in Persia, Tamuku	In case of telephonic communication wires are used or wireless protocol is also used such as WAP protocol. In current stage Internet and www concepts are same and used through wire and wireless protocols too

Angros = Angros are messengers who can transmit information from a distance of 1677 miles in just seven days on horseback and ninety days on foot.

Tamuku = A person with a dappu to convey important messages among the villagers.

Dappu = A kind of drum.

Table 2 delineates three temporal dimensions: the Prehistoric period before writing, after the advent of writing, and post-invention of the telephone, internet, and WWW. Primitive communication relied on signals like fire, smoke, and drums before written language emerged, while written communication began thereafter. The introduction of the telephone, internet, and WWW revolutionised information seeking, facilitating intelligent signal usage. Writing materials transitioned from eggshells and clay tablets to digital devices in the digital era, while communication mediums evolved from speech and gestures to letters, telegraphs, and contemporary modes like text messages and video calls. Pre-writing era lacked formal message couriers but utilised pigeons, foot messengers, and horseback messengers, contrasting with modern reliance on wires, air, and electronic channels for message delivery

It is the instinct inquisitiveness of all human beings to know the component(s) used for preparing any material thing. The following table 3 is the representation of the materials used for communication media.

Table 3: Materials used for communication media

Media	Materials used
Cave paintings / Pictography	Stone, Rock for engraving
Telegram	Paper and electrical signal
Letter	Metal, lead, wax-coated wooden tablets, pottery fragments, animal skin and papyrus and in the contemporary period, paper is mostly used
Telephone	Cable wire, dial box and mouthpiece
Internet	Computer, Internet Protocol
www	Web and spectrum

The above table 3 describes the varieties of materials used to make different communication media. In the primitive age, stones and rocks were used for engraving as pictography. Later, paper and electronic signals were used for telegrams. It is seen from the above table that "Letters" may be made of metal, lead, wax-coated wooden tablets, pottery fragments, animal skin, papyrus, paper. Cable wire, dial box and mouthpieces were used to prepare the telephone. Computer and internet protocol are necessary for the Internet. WWW (World Wide Web) is based on web and spectrum.

Signs and symbols always signify some information, whether it is in the ancient period or the era of web domination. The following table 4 shows the manifestation of the dissemination of Information through signs and symbols.

Table 4: Dissemination of information through signs and symbols

Ancient Period		The Era of Internet Domination		Remarks
Signal used	Reflection of Information	Signal used	Reflection of Information	
Fire	Long distances, people could communicate with fires. If there were a threat of invasion, the defenders would make fires on the top of hills or mountains.	Open blue circle 	The message is ready for sending.	Both are the indication of long distance.
Drums, Smoke	Signal danger and a call to arms		No entry	Almost the same information signifier

Ancient Period		The Era of Internet Domination		Remarks
Signal used	Reflection of Information	Signal used	Reflection of Information	
Totems	Spiritual significance and emotions		Emotions	This is the manifestation of equivalent Information
Horns	For Alarm	Red Triangle 	Failure in message-sending	Both are same
Banners	Rightness		Gender specification	Rightness is reflected in both cases
Polished Sword & Mirror-like copper disk	Strategic positional communication	Open blue circle with a checkmark 	The message is ready for sending.	Almost same
Flash of light	Predetermined positive instruction	Filled blue circle and checkmark 	Massage has been delivered successfully.	Indication of positivity

Table 4 represents the type of signal/symbols used in the ancient period and the era of internet domination. It is noticed that different symbols/signs were used to indicate different meanings in the ancient era as well as the era of air (era of the web) domination. In the ancient period, fire means long-distance communication. Drums and smoke were dangerous. Totems were used for spiritual significance. For alarming something, horns were blued. Rightness was signified by banners. A polished sword and flash of light signify strategic position and predetermined positive instruction, respectively.

In the present era, signals/symbols like Open blue circle, Open blue circle with a checkmark, filled blue circle with a checkmark, Red Triangle, Emoji, etc., are

used to disseminate information. The signs and symbols used for disseminating in the present and the olden days are almost the same in every respect.

7. Discussion

The findings of the research have revealed several key insights: Firstly, communication media evolved from cave paintings and pictography in the primitive age to modern mediums such as telegram, letters, telephone, internet, and WWW. Secondly, before the advent of writing, communication relied on symbols like smoke, fire, drums, and horns, which transitioned with the invention of writing and the internet. Thirdly, writing materials progressed from eggshells and clay tablets to digital keyboards. Fourthly, the means of communication transformed from speech and gestures to written forms like letters, telegrams, and contemporary methods such as internet-based communication. Additionally, telegram served as a vital tool for both domestic and international communication. Moreover, pigeons historically played a significant role as message couriers. Lastly, contemporary communication still utilises symbols and signs for conveying information, such as the "open blue circle" indicating a message ready for sending, reminiscent of ancient communication practices.

8. Conclusion

This study provides a comprehensive examination of the evolution of information seeking practices from ancient times to the internet-dominated era, offering valuable insights into the cognitive processes underlying human communication and knowledge acquisition. The research illuminates how communication media have transformed over millennia, from primitive cave paintings and verbal gestures to modern mediums like telegrams, letters, telephones, and the internet. Significantly, it underscores the enduring significance of signs and symbols in communication, tracing their evolution and impact across different historical periods. Moreover, the study highlights the continuity in communication patterns despite technological advancements, emphasising the timeless nature of human information-seeking behaviour. While contemporary communication mediums offer unprecedented connectivity and convenience, they are rooted in age-old communication principles, suggesting a fundamental and enduring pattern in the human quest for information. Ultimately, this research contributes to a deeper understanding of the complex interplay between communication technologies, human cognition, and societal development, shedding light on the enduring dynamics of information seeking across ages.

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Research Output on Altmetrics during 2012-22: a scientometric assessment

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Abstract

This paper presents a comprehensive examination of research output in altmetrics from 2012 to 2022, utilising data from the Scopus database. Analysing 1,253 publications, with an average of 113.9 annually. It scrutinises the trajectory of scholarly output, noting significant growth from 10 publications in 2012 to 174 in 2021, indicating increasing interest in altmetrics. Through a multifaceted approach, the study dissects characteristics of this literature, emphasising growth dynamics. The primary aim was a scientometric analysis of global altmetrics publications, including growth patterns, authorship, core journals, keywords, citations, and institutions. Methodologically, it identifies pivotal journals, core subjects, influential authors, geographical distribution, prolific institutions, language preferences, and citation-based metrics. Findings reveal core elements shaping altmetrics research, distribution patterns across regions, and influential contributors, enriching understanding of the scholarly landscape and enhancing scientometric methodologies within specialised domains.

Keywords: Altmetrics, Bibliometrics, Bradford's Law, Citation-based indicators, Doubling time, Lotka's Law, Scientometrics

1. Introduction

A scientometric study employs statistical methods to assess and quantify the development of a particular subject, offering insights into research trends and enabling predictive projections. This approach spans various domains, including physical science, chemical science, biological science, earth science, and social science. Many studies have quantitatively analysed literature in different fields, laying the groundwork for the current study's aim of contributing to the discourse on altmetrics publications globally. Altmetrics, or "alternative metrics," evaluate scholarly impact beyond traditional citations, leveraging online and social media sources for a more comprehensive view. They offer valuable insights in fields where traditional metrics may fall short and aid in societal impact assessment, digital influence tracking, and trend identification. While altmetrics broaden perspectives, their interpretation should consider biases and be complemented by traditional metrics. By examining 1,253 publications, including articles, conference papers, reviews, book chapters, editorials, letters, notes, etc., from the Scopus database, the study explores growth patterns, authorship trends, core journals, subject areas, keywords, citation-based indicators, productive countries, and core institutions in altmetrics. Despite its thoroughness, the study has

limitations, including reliance on data up to February 2, 2023, and focus on Scopus-indexed literature, potentially missing other relevant sources and aspects of impact assessment.

2. Literature review

Several studies have contributed to the understanding of research trends and methodologies within the realm of altmetrics. Dutta and Rath (2013) examined 1198 articles on Cosmology research in India, collected from the Web of Science spanning 1999 to 2012. Das and Mishra (2014) analysed 70 altmetrics publications, focusing on growth, authors, contributing countries, institutions, and highly cited publications. Samanta and Dutta explored altmetric scores for top-cited papers across diverse subject domains. Baskaran (2020) investigated global publication trends in altmetrics research from 2012 to 2015, while Nath and Jana (2021) provided a scientometric review of altmetrics research globally from 2012 to 2019. Teli and Dutta (2016) demonstrated a correlation between article citations and retrievals from the Web of Science within specific astrophysics domains. Bornmann, Haunschild, and Mutz (2021) analysed scientific growth trends using various databases, contributing to understanding the evolution of scientific research. Gonzales et al. (2023) examined soil contamination treatment technology trends, highlighting increased research activity in Environmental Science. Damar and Koksalmis (2024) conducted a bibliometric analysis of healthcare metaverse research, establishing a thematic categorisation for future research in the field.

3. Objectives of the study

The study has aimed to conduct a comprehensive scientometric analysis of all altmetrics publications worldwide. The primary objectives of the study include:

i. examining the growth pattern of literature

ii. authorship pattern in this subject domain

iii. identifying the core journals, subject areas, and keywords within the subject domain

iv. analysis of citation-based indicators in this subject domain

v. identifying the countries with the highest research productivity in this subject

vi. recognising the core institutions actively researching in this subject domain.

4. Methodology

In this research, bibliographic data were gathered related to altmetrics from the Scopus database as of February 2, 2023, from the Central Library of Calcutta University. The 'TITLE-ABS-KEY' field was applied to retrieve scientific literature using the keyword 'altmetrics,' resulting in 1,253 publications. The Scopus database is renowned for its comprehensiveness in covering all aspects of science and technology. Subsequently, 1,253 publications were analysed, including articles (895), conference papers (168), reviews (69), book chapters (43), editorials (38), letters (23), and notes (11), others (6). Besides MS Excel and scientometrics tools like biblioshiny were used in this study.

5. Data analysis and interpretations

5.1 *Growth pattern of this subject domain*

Annual Growth (AG) of Publication

Table 1 and figure 1 show the literature's growth and cumulative growth over the years and the year-wise percentage of total publication share. These findings suggest a steady increase in the growth of literature over

the years, with a peak in 2021 in terms of year-wise % of total publication share. In 2020 and 2021, the percentage of full publication share is relatively high compared to the earlier years. However, in 2022, there was a slight decrease in the year-wise % of total publication share.

Table 1: Year-wise distribution of number of publications

Year	Growth of Literature	Cumulative Growth of Literature	Year-wise % of total Publication Share
2012	10	10	0.80
2013	37	47	2.95
2014	54	101	4.31
2015	92	193	7.34
2016	102	295	8.14
2017	141	436	11.25
2018	151	587	12.05
2019	163	750	13.01
2020	171	921	13.65
2021	174	1095	13.89
2022	158	1253	12.61

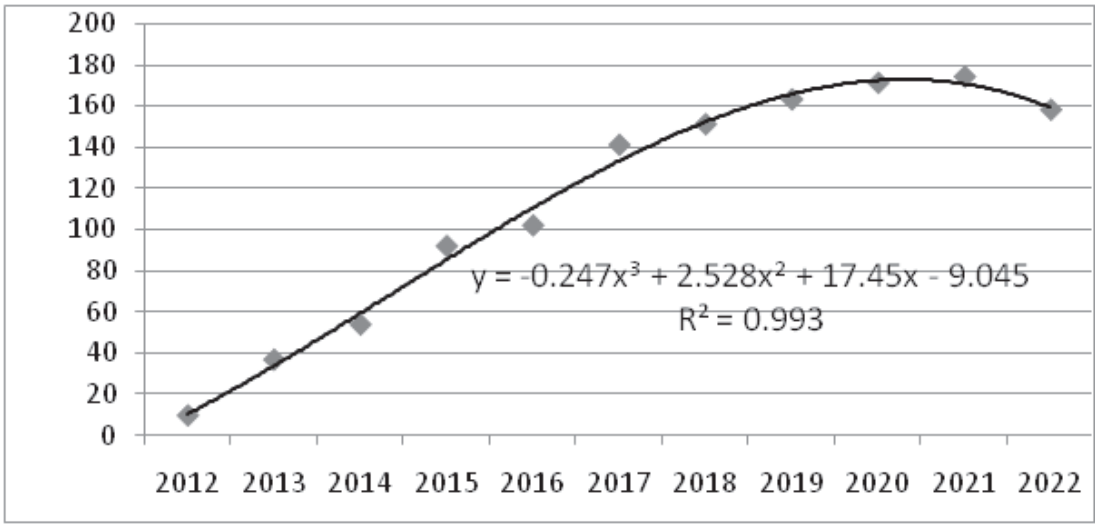

Figure 1: Cumulative growth curve of publication

Annual Growth Rate (AGR) of publications

To compute the Annual Growth Rate (AGR) of publications, Compound Annual Growth Rate (CAGR) formula can be employed. The CAGR formula is as follows:

$$AGR = \frac{\text{End Value - First Value}}{\text{First Value}} \times 100$$

Between 2012 and 2022, a total of 1,253 publications focused on altmetrics research were published. The peak in publications, reaching 174, occurred in 2021, while the lowest number, at just 10, was recorded in 2012. On average, approximately 113.91 publications were published each year. Table 2 illustrates a consistent upward trend in research publications on altmetrics throughout the study period from 2012 to 2022.

Table. 2: Annual Growth Rate (AGR) of publications

Year	Growth of Literature	Cumulative Growth of Literature	First Value	End Value	Annual Growth Rate
2012	10	10	-	10	-
2013	37	47	10	47	370.00
2014	54	101	47	101	114.89
2015	92	193	101	193	91.09
2016	102	295	193	295	52.85
2017	141	436	295	436	47.80
2018	151	587	436	587	34.63
2019	163	750	587	750	27.77
2020	171	921	750	921	22.80
2021	174	1095	921	1095	18.89
2022	158	1253	1095	1253	14.43

Table 2 also offers year-wise calculations for total publications' annual growth rate (AGR). The AGR indicates a decline from 370.00 in 2012 to 14.43 in 2022, signifying a downward trend in the growth rate.

Relative Growth Rate(RGT) and Doubling Time(DT)

The Relative Growth Rate (RGR) signifies the rise in publications or pages within a specific time frame. This definition is derived from the concepts of relative growth rates used to analyse growth in altmetrics. The average relative growth rate (R) over the specified interval can be computed using the following equation.

In contrast,

- 1-2 R represents the mean relative growth rate over a specific interval.
- Log W1 indicates the natural logarithm of the initial number of publications.
- Log W2 signifies the natural logarithm of the final number of publications after a specified interval.
- T2-T1 denotes the time difference between the initial time and the final time, with the year as the unit of time.

- The Relative Growth Rate (RGR).
- The formula for 1-2 R is Log W2 - Log W1 / (T2-T1).
- Doubling Time (DT) can be calculated as 0.693/R.

Table 3: Relative Growth Rate (RGT) and Doubling Time (DT)

Year	Growth of Literature	Cumulative Growth of Literature	W1	W2	Relative Growth Rate	Doubling Time
2012	10	10		2.3		
2013	37	47	2.3	3.85	1.55	0.45
2014	54	101	3.85	4.62	0.77	0.90
2015	92	193	4.62	5.26	0.64	1.08
2016	102	295	5.26	5.69	0.43	1.61
2017	141	436	5.69	6.07	0.38	1.82
2018	151	587	6.07	6.37	0.30	2.31
2019	163	750	6.37	6.62	0.25	2.77
2020	171	921	6.62	6.82	0.20	3.47
2021	174	1095	6.82	7.00	0.18	3.85
2022	158	1253	7.00	7.13	0.13	5.33

Table 3 reveals that the Relative Growth Rate (RGR) declined from 1.55 in 2012 to 0.13 in 2022. The peak value of 1.55 corresponds to 2012, while the lowest value of 0.13 is observed in 2022. In parallel, the Doubling Time of publications gradually increased, moving from 0.43 in 2012 to 5.33 in 2022.

5.2 *Authorship pattern of this subject domain*

Table 4: Distribution of authorship pattern

SL. No.	No. of Author	No. of publications	Percentage
1	1	294	23.46
2	2	362	28.89
3	3	242	19.31
4	4	150	11.97
5	5	89	7.10
6	6	46	3.67
7	7	26	2.08
8	8	13	1.04
9	9	5	0.40
10	10	8	0.64
11	11	1	0.08
12	12	3	0.24
13	13	1	0.08
14	14	1	0.08
15	15	1	0.08
16	>15	11	0.88

Analysis of authorship patterns reveals distinct trends, with the majority of publications involving two authors (28.89%), followed by single authors (23.46%) and three authors (19.31%). There's a consistent decrease in percentage as the number of authors per publication increases, highlighting a preference for fewer authors. Solo-authored publications contribute significantly (23.46%), while collaborations with 3 and 4 authors collectively contribute 31.28%, indicating a notable mid-range authorship category. Duet collaborations (2 authors) are the most common (28.89%), and very small teams (3-4 authors) contribute 31.28%. Larger teams (>15) are infrequent, collectively contributing only 1.44%, emphasizing a preference for smaller teamwork patterns, with teams of 10 or fewer authors contributing 75.09% of publications.

Table 5: Relative distribution of publications over team size

Team size	No. of Authors	No. of Publications	Percentage
Solo	1	294	23.46
Duet	2	362	28.89
Very small	3--4	392	31.28
Small	5--10	187	14.92
Medium	11--15	7	0.56
Large	>15	11	0.88

Table. 6: Core authors of this subject domain

SL. No.	Rank	Author	No. of Publications	Percentage	Total Citation	Citation per Paper	H-index	PY_start
1	1	Thelwall, M.	46	3.67	3257	70.80	29	2013
2	2	Bornmann, L.	38	3.03	1487	39.13	17	2014
3	3	Haunschild, R.	31	2.47	710	22.90	13	2015
4	4	Costas, R.	26	2.08	1597	61.42	14	2013
5	5	Peters, I.	25	2.00	1597	63.88	14	2013
6	5	Haustein, S.	25	2.00	2095	83.80	18	2013
7	6	Torres-Salinas, D.	15	1.20	339	22.60	7	2013
8	6	Holmberg, K.	15	1.20	766	51.07	11	2013
9	7	Bowman, T.D.	14	1.12	588	42.00	11	2014
10	7	Alhoor, H.	14	1.12	180	12.86	7	2013

Thelwall emerges as the leading contributor with 46 publications (3.67% of the total), showcasing a significant impact with substantial total citations (3257) and a high citation per paper (70.80) since 2013. Bornmann follows with 38 publications (3.03% of the total), exhibiting a reasonable citation per paper (39.13) and growing influence since 2014. Haunschild holds the third position with 31 publications (2.47% of the total), showing moderate impact since 2015. Costas ranks fourth with 26 publications (2.08% of the total), demonstrating a strong impact with notable total citations (1597) and a high citation per paper (61.42). Peters and Haustein tied for fifth place, each with 25 publications (2.00% of the total), showcasing consistent impact since 2013. These authors, especially Thelwall, Costas, Peters, and Haustein, shape the field with their high citation numbers and ratios, highlighting individual impactful works and the dynamic

evolution of the field with a blend of seasoned and emerging influences.

Author productivity and Lotka's Law of this subject domain

Table 7: Author productivity

Sl. No.	Documents written	No. of Authors	Proportion of Authors
1	1	1835	0.787
2	2	289	0.124
3	3	81	0.035
4	4	52	0.022
5	5	18	0.008
6	6	16	0.007
7	7	5	0.002
8	8	7	0.003
9	9	5	0.002
10	10	5	0.002
11	11	4	0.002
12	12	2	0.001
13	13	1	0
14	14	2	0.001
15	15	2	0.001
16	23	1	0
17	25	2	0.001
18	26	1	0
19	31	1	0
20	38	1	0
21	46	1	0

Lotka's Law of author productivity, often represented by an inverse square law, reveals a distinct distribution in authors' document output. Table 7 confirms that 78.7% of authors contribute only one document, consistent with Lotka's expectation of a predominantly minimally productive majority. As the document count per author increases, the proportion of authors decreases, illustrating a skewed distribution where a few authors are highly productive while most contribute fewer documents. This pattern strongly supports Lotka's Law, underscoring the significance of highly productive individuals in scholarly publishing and its relevance for understanding bibliometric patterns and research evaluation methodologies.

5.3 *Core journals (Sources) and Bradford's Law*

Bradford's Law is a bibliometric principle describing the distribution of journal articles in a particular field. A small core of journals (Bradford core) will contain most articles on a specific subject. The law is often expressed as a three-zone model, where journals are classified into core, middle, and fringe zones based on productivity. Table 8 shows the list of core journals along with their rank, frequency, and cumulative frequency.

Table. 8: Core journals (Sources) of this subject domain

Sl. No.	Core journals	Rank	Frequency	Cum. Freq
1	Scientometrics	1	158	158
2	Journal Of Informetrics	2	44	202
3	Profesional De La Informacion	3	24	226
4	Library Philosophy And Practice	4	22	248
5	17th International Conference on Scientometrics And Informetrics, Issi 2019 – Proceedings	5	21	269
6	Proceedings Of The Association For Information Science And Technology	6	20	289
7	Plos One	7	19	308
8	Journal Of The Association For Information Science And Technology	8	18	326
9	ISSI 2017 - 16th International Conference On Scientometrics And Informetrics, Conference Proceedings	9	17	343
10	Handbook Bibliometrics	10	15	358
11	Online Information Review	11	15	373
12	Aslib Journal Of Information Management	12	13	386
13	Lecture Notes In Computer Science (Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics)	13	13	399
14	Proceedings Of The Acm/Ieee Joint Conference On Digital Libraries	14	12	411
15	Quantitative Science Studies	15	12	423

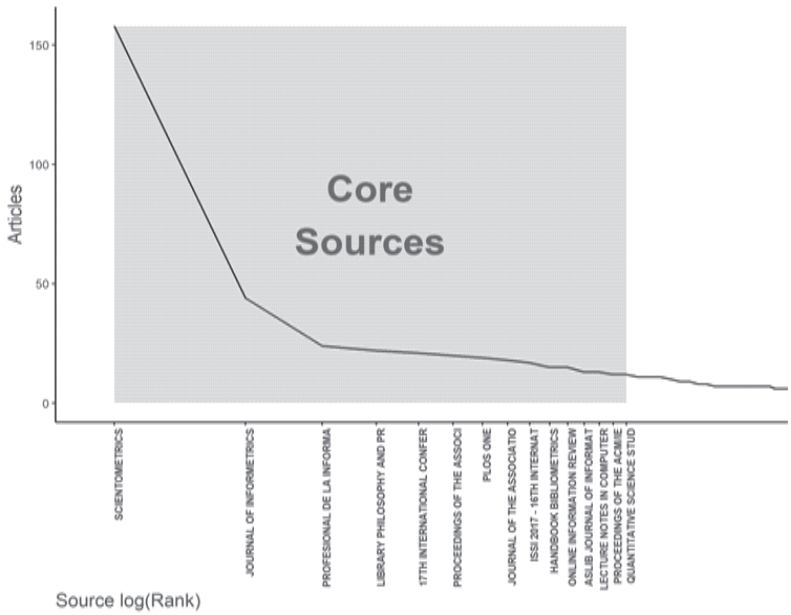

Figure 2: Sources and Bradford's Law

Let's analyse the findings using Bradford's Law:

Bradford's Law suggests that a minority of journals will dominate publications in a field. To identify core journals, examine the top-ranked ones and assess if their distribution aligns with Bradford's Law. Typically, leading journals like "Scientometrics" should exhibit markedly higher frequencies. In this case, "Scientometrics", with a frequency of 158 out of 423, conforms to Bradford's Law, highlighting the dominance of a select few journals. Evaluate if the table reflects middle and fringe zones, characterised by decreasing frequency. The cumulative frequency column pinpoints where core, middle, and fringe zones diverge, a key aspect of Bradford's Law.

5.4 *Core subject area of this subject domain*

Table. 9: Core subject area of this subject domain

SL No.	Subject	No. of Publications	Percentage
1	Social Sciences	743	36.98
2	Computer Science	570	28.37
3	Medicine	222	11.05
4	Decision Sciences	119	5.92
5	Mathematics	107	5.33
6	Arts and Humanities	75	3.73
7	Engineering	50	2.49
8	Business, Management and Accounting	47	2.34
9	Multidisciplinary	38	1.89
10	Biochemistry, Genetics and Molecular Biology	38	1.89

Table 9 presents the breakdown of publications across the top 10 subject categories within the altmetrics domain. The data reveals that Social Sciences, with 36.98% of the publications, holds the most extensive share among the listed subject categories, making it the largest category. Computer Science follows closely with a substantial share of 28.37%, securing its position as the second-largest contributor. Medicine also accounts for a significant portion at 11.05%. Additionally, Decision Sciences and another subject category hold a substantial share of publications at 5.92% and 5.33%, respectively.

5.5 *Core keywords of this subject domain*

Table: 10: Core keywords of this subject domain

SL No.	Subject	No. of Publications	Percentage
1	Altmetrics	824	32.25
2	Human/ Humans	382	14.95
3	Bibliometrics	312	12.21
4	Social Media	300	11.74
5	Article	154	6.03
6	Journal Impact Factor	131	5.13
7	Twitter	118	4.62
8	Publication	117	4.58
9	Citation Analysis	111	4.34
10	Social Networking (online)	106	4.15

Table 10 presents the top 10 high-productivity keywords associated with over 1,253 publications. Altmetrics dominates with 824 publications (32.25%), followed by human-related topics like digital humanity with 382 publications (14.95%). Bibliometrics, involving quantitative analysis of bibliographic information, ranks third with 312 publications (12.21%). Significant contributions come from social media, Twitter, and social networking, highlighting the role of online platforms. Articles and journal Impact Factor with 154 and 131 publications respectively underscore the focus on publication impact, while citation analysis represented by 111 publications explores scholarly impact through citations. The broader "Publication" category with 117 publications covers diverse aspects within the altmetrics domain.

5.6 *Analysis of citation based indicators in altmetrics*

Table 11: Analysis of citation based indicators

Particulars	No.
Total No. of Publications	1253
No. Cited Publications	1050
No. of Uncited Publications	203
Total Citation	21410
h-Index	66
h-core Citation	4356
Upto h-Citation	9938
h-excess Citation	5582
h-tail Citation	11472
Net Excess Citation	17054
Onesies	131
Twicies	102
Thricies	85
i10 index	445
e-Index	130.57
R-Index	146.32
a-Index	324

Table 11 displays data on 1,253 publications, with 1,050 cited and 203 uncited, accumulating 21,410 citations. Onesies (131), Twicies (102), and Thricies (85) signify publications with one, two, and three citations respectively, showcasing diverse citation patterns. The h-index of 66 indicates 66 publications with at least 66 citations each, reflecting robust citation impact. Metrics such as h-core citation (4,356), upto h-citation (9,938), h-excess citation (5,582), h-tail citation (11,472), Net Excess Citation (17,054), i 10 index (445), e-index (130.57), R-index (146.32), and a-index (324) further delineate citation trends and impact. The dataset suggests growing publication numbers and impact, with citations becoming more widespread, illustrating the multifaceted nature of altmetrics.

5.7 *Highly productive countries carrying out research in this subject*

Table 12: Highly productive countries carrying out research in this subject

SL No.	Country	No. of Publications	Percentage
1	United States	273	21.79
2	United Kingdom	159	12.69
3	China	119	9.50
4	Germany	112	8.94
5	Spain	108	8.62
6	India	79	6.30
7	Iran	72	5.75
8	Canada	71	5.67
9	Netherlands	62	4.95
10	Brazil	55	4.39

Table 12 provides insight into the distribution of publications among the top 10 productive countries in the altmetrics field. While 71 countries were engaged in altmetrics research, the United States claimed the leading position with the most substantial share, contributing 21.79% of the publications. The United Kingdom secured second place with a share of 12.69%, followed by China at 9.50%, Germany at 8.94%, and Spain at 8.62% in terms of their respective shares of publications.

5.8 *Core institutions carrying out research in this subject*

Table. 13: Core institutions carrying out research in this subject

Sl. No.	Institutions	No. of Publications	Percentage
1	University of Wolverhampton	49	3.91
2	Administrative Headquarters of the Max Planck Society	37	2.95
3	Wuhan University	34	2.71
4	Max Planck Institute for Solid State Research	31	2.47
5	Universiteit Leiden	30	2.39
6	Universidad de Granada	27	2.15
7	Leibniz-Informationszentrum Wirtschaft	25	2.00
8	Nanyang Technological University	24	1.92
9	Consejo Superior de Investigaciones Científicas	20	1.60
10	University of Montreal	20	1.60

A total of 161 organisations contributed to the comprehensive research output of this study. The scientometric profile of the top 10 institutions is outlined in table 13. The findings reveal that the University of Wolverhampton stands as the most productive institution in the field of altmetrics research, with 49 publications, accounting for 3.91% of the total. Following closely is the Administrative Headquarters of the Max Planck Society with 37 publications (2.95%), Wuhan University with 34 publications

(2.71%), Max Planck Institute for Solid State Research with 31 publications (2.47%), Universiteit Leiden with 30 publications (2.39%), and Universidad de Granada with 27 publications (2.15%).

6. Discussion

The study illustrates a notable increase in altmetrics research publications from 2012 to 2022, peaking in 2021 but showing a slight decrease in 2022, indicating a downward trend in growth rate. The prevalence of publications with two authors, followed by single and three authors, suggests a preference for fewer authors per publication. Influential contributors such as Thelwall, Costas, Peters, and Haustein shape the field with high citation numbers, reflecting varying citation patterns and emphasising individual impactful works. A concentrated number of journals, led by "Scientometrics," dominate publication frequency, aligning with Bradford's Law. Social Sciences and Computer Science emerge as leading subject categories, with other categories contributing variably. Top keywords like altmetrics, human/humans, and bibliometrics underscore the diverse focus within the field. Citation impact metrics such as the h-index, h-core citation, and net excess citation signify robust impact and the growing influence of altmetrics research, complemented by indices like the i10 index and e-index. Productivity is notably led by the United States and the University of Wolverhampton, followed by other prominent contributors like the United Kingdom and the Max Planck Society.

7. Conclusion

The study provides comprehensive insights into the growth, authorship patterns, core authors, journals, subject areas, keywords, citation-based indicators, highly productive countries, and institutions in altmetrics research. Future research could delve deeper into specific subdomains within altmetrics, analyse the impact of emerging technologies on research dissemination, and explore interdisciplinary collaborations to address complex societal challenges. Additionally, longitudinal studies tracking the evolution of altmetrics research over time could offer valuable insights into its trajectory and potential future developments.

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