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Open Access Research Publications in Indian Central Universities: A Comparative Study Through Bibliometric Approach

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This study was carried outin order to assess the status of Open Access Research (OAR) undertaken and published at three top Central Universities of India namely,Jawaharlal Nehru University (JNU) in New Delhi, Banaras Hindu University (BHU) at Varanasi, Jamia Millia Islamia (JMI) in New Delhi, University of Hyderabad (UOH)in Hyderabad and Aligarh Muslim University (AMU)in Aligarh. The objectives of the research were framed for the Open Access Research publications and data extracted from the Web of Science database. These universities ranked 2nd, 3rd, 6th, 9th and 10thas per the National Institutional Ranking Framework (NIRF) in the year 2021.A bibliometric approach was undertaken to satisfy the aboveframed objectives of the study. This simplified search strategy was applied by using affiliations of all three Universities viz. JNU, BHU, JMI, UOH and AMU separately in such a way that a maximum accuracy could be maintained. The result of the study shows that the UOH produced more OA publications with minimum utilization of financial resources in which 46.15% research are Gold Open Access, that is more than the other four universities. The study explores that close access research (in paywall journals) are published more than open access; however, it would be advantageous if such type of research is published in open access which will be freely available to

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the public because public funds are utilized to undertake the research in the above-mentioned universities. The study may also be useful to conduct and extend to other central universities as well as state universities and government organizations to evaluate the open access research, especially where public funds are utilized for the purpose of conducting research and universities may help their researchers by reasonable fund allocation for Article Processing Charges and encouraging for gold access or green access journals.

Keywords: *Open Access Research, NIRF, Indian Universities, Research Trend*

0 INTRODUCTION

Open Access Publishing (OAP) is being discussed in detail in the academic institutions and universities, which are well-known for their research activities where teachers, research scholars, and scientists are engaged as an innovators and producers of research through scholarly communication. Every year, they publish a number of research results in close access publications, and such publications could not be accessed due to some constraints. The funding issues are one of the most serious concerns for the academic institutions since it is more often a hindrance to meet the requirements of the academic community to access the research work done in the same country and sometimes in the same institution. Open access research can be a tool to resolve complexities of subscription policy and copyright issues which is a serious apprehension.

In Indian universities,which are renowned for their research activities, where professors, research scholars, and scientists are active in carrying out research, publishing research papers in open access publications as well as paywall journals has become a heated issue. This is true, not only in India but in the globally scenario. At a slow and steady pace, Open Access Researchis gainingwide popularity among Indian scientists, researchers, faculty and scholars. Researchers and scientists publish their findings every year in closed access publications andthese publications cannot be accessed due to financial and other restrictions. The funding issues are a serious concern for the academic institutions because budget is often a hindrance to meet the requirements of the academic community to access the research work done in the same country and often in the same institutions. The Government provides a huge budget to the universitiesfor the subscription of journalsand research databases and also encourages the faculty, researchers and scientists to conduct research and produce a scientific result that should be available to its recipients free of cost; the close access causes a hindrance towards achieving this objective. Open Access Research can be a tool to resolve the complexities of subscription policy and copyright issues.

The National Institutional Ranking Framework (NIRF) was approved by the Ministry of Human Resource Development and launched on 29th September 2015, which outlines the methodology to rank institutions across the country. This methodology draws from the complete recommendation of a broad comprehension that is arrived at by a Core Committee setup by MHRD to distinguish the broad parameters for ranking various universities and institutions. With this view, the three above mentioned universities were selected for the comparative study and to study their performance in order of Open Access Research results.[4]

1 REVIEW OF LITERATURE

The various literatures of Open Access Publishing were reviewed comprehensively to understand the open access research phenomena across the world.Open Access electronic resources are attracting the scientist and academic researchers due to easy access and low cost if the accuracy is assured to them.[13]Publishers can also be more vibrant by maintaining the quality in promoting the open access research.[22]In some Indian Universities open access is provided to around 23 per cent of all publications,but this proportion of OA publications is very low than worldwide universities.[25]At this movement, India should take a deeperperception and make mandatory for all of its institutions and funders to provide OA for its research that will maximise the positive impact.[21]

It is has been observed that top ranked universities in Asia are not much interested and actively participating in the Open Access Movement.[5]It would be appropriate to mention that the top 10 universities in Germany still tends to publish their research publications in the closed access models.[2]Latin American Scholars have been profoundly impacted from the Open Access that transformed their mode and style of participation in accessing and producing scholarly communications and recognised that OA has played an entirelydiverse role among the faculty of higher education of Latin America than Anglo-Americans and a large number of European countries.[6]Academic librarians in Nigerian private universities have a positive perception yet the involvement in spreading awareness is very low.[12] East African universities have a low stage of embracing Open Access and researchers are interested to access the full text information resources through open access institutional repository.[24]

The literature also noticed in their conclusion that awareness, attitude, performance expectancy, Internet self-efficacy, and facilitating conditions are determinants of the adoption and use of OA publishing.[9]There are many barriers which hinders the proliferation of OA,that can be classified as legal framework, IT infrastructure, business models, indexing services and standards, academic reward systems, marketing and critical mass[14] and it was also observed that

inadequate online publishing skills and slow internet connectivity are the main hindrance that deterred the researchers to publish the research findings in open access journals.[15] Publishers are developing mechanism to reduce the hindrances to manage open access publishing cost.[26]It is described that OA provides an opportunity for institutions, funding agencies and national science policy officers to comprehend the expansion of OA in the country. [27]

OA publications are systematically more cited and green open access impacts more than other types of OA.[18]It has been noted thatseveral researchers in Tanzanian public universities are positively aware about OA models and use the open access research however, they still publish their publications in closed access due to lack of skills and supportive policies.[16]It is recommended that the articles which are freely available outside of the established infrastructure should not be counted as Open Access and made mandatory for funders and universities to make OA.[17]A term of a new model of diamond open access was coined as a specific form that shape the future of the academia and academic publishing and it was argued that author fees or article processing charges is a commoditization of the academic world.[19]The researcher examined that for 100% open access, self-archiving is mandatory for researcher's employers and funders, which is already recommended to become mandatory by USA and UK to implement by the universities.[20]

A bibliometric approach of open access research explains the publishing and research trends, in which various issues are analysed. Through this study, authorship pattern, funding agencies, the strength of research output, and collaborations among the distinct authors, organizations are studied. A number of bibliometric studies have been identified that were performed to assess, evaluate and map the research output of universities and institutions. [3,7,10,11]

2 OBJECTIVES

The following objectives of the study were framed as below:

- To find out the status of Open Access Research in top fivecentral universitiesranked in NIRF
- To assess the total annual research output of the universities
- To analysethe annual growth as regards to OA research
- To investigate the top funding agencies.
- To find out the most prolific authors in producing the maximum OA research.
- To find out the utilization of financial resources by the five Central Universities during 2012-20.

3 SCOPE AND LIMITATIONS

The study is conducted on the Open Access Research Publications during

2011-2020 in the topfiveCentral Universities of India ranked in NIRF and has restrictions to the five universities only for open access research publications upto the 10th rank. A further study may be expanded to large numbers of the universities to know the status of the open access research in other universities.The selected five central universities for this study viz. JNU, BHU, JMI, OUH, and AMU were ranked 2nd, 3rd, and 6th, 9th and 10threspectively as per the rankingprovided by the National Institutional Ranking Framework in 2021.

4 METHODOLOGY

This study is conducted to assess Open Access Research at the top fiveCentral Universities of India upto the 10th rankNehru University (JNU) [23], Banaras Hindu University (BHU)[8], Jamia Millia Islamia (JMI), University of Hyderabad (UOXH) [1], and Aligarh Muslim University (AMU) ranked 2nd, 3rd, and 6th, 9th, and 10th in the National Institutional Ranking Framework (NIRF) in 2021.

A bibliometric approach was undertaken to satisfy above framed research questions. Data was extracted from the Web of Science database.

The advanced search strategy was applied by the researchers to extract the data in such a way that maximum accuracy could be maintained. The data in CSV format were extracted on 2nd November 2021 from Web of Science core collection indexed in SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI for all three Universitiesthat areJawaharlal Nehru University, Banaras Hindu University, Jamia Millia Islamia, University of Hyderabad and Aligarh Muslim University separately. The simple search was done using affiliations and the criteria set up between the period of 2011-2020 asALL FIELDS: (Name of the University) for 2011-2020 all publications andall document types in all languages.

Later on, based on the achieved results for selected universities through simple search, data was refined by selecting the field-Open Access Research publications in three universities:

A. The results of all publications (12275) for Jawaharlal Nehru University were refined by Open Access: (OPEN ACCESS), Timespan: 2011-2020, Indexes SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI and searched for ALL FIELDS: (Jawaharlal Nehru University) which resulted in 3283 Open Access Publications.
B. The results of all publications (13676) for Banaras Hindu University was refined by Open Access: (OPEN ACCESS), Timespan: 2011-2020, Indexes SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI and searched for ALL FIELDS: (Banaras Hindu University) which resulted in 3035 Open Access Research Publications.

C. The results of all publications (6011) for Jamia Millia Islamia were distinguished by Open Access: (OPEN ACCESS), Timespan: 2011-2020, Indexes SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI and searched for ALL FIELDS: (Jamia Millia Islamia) which resulted in 1357 Open Access Publications.
D. The results of all publications (36254) for University of Hyderabad were refined by Open Access: (OPEN ACCESS), Timespan: 2011-2020, Indexes SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI and searched for ALL FIELDS: (University of Hyderabad) which resulted in 9017 Open Access Publications.
E. The results of all publications (9334) for Aligarh Muslim University were refined by Open Access: (OPEN ACCESS), Timespan: 2011-2020, Indexes SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI and searched for ALL FIELDS: (Aligarh Muslim University) which resulted in 2634 Open Access Publications.

Since the study is inclusively related to the open access publications of universities, therefore a simple search strategy of affiliations during period of 2011-2020 for Open Access Research was used.The data were analysed by using the Web of Science Result Analysis, MS Excel, and Biblioshiny package of R for making a comparative statement to extract the results.

5 ANALYSIS AND DISCUSSION

PUBLICATIONS OF THE UNIVERSITIES

The performance of universities isdeterminedon the basis of research publications and innovations which ultimately contribute to the knowledge and economy of the country and ranking of the institution. The data in Table-1 (a)depicts that UOH produced 36254 publications which are almost three times higher than the publications of JNU (12275), BHU (13676), JMI (6011), and AMU (9334) during the year 2011-2020.

It is also found from Table-1(b) that publications of UOH have always been considered to be high since 2011, though, all the five universities reported continuous growth in the number of overall publications. It is pointed out from the Table-2 resources and produced the maximum number of publications. As far as the Open Access Publications are concerned, it is interesting to note that the UOH is utilizing minimum fundsas well as producing the maximum Open Access Publications than all four universities. It has also been revealed from the study in Table-1 (b) that UOH produces 9017 (24.m.o……..88%) which is more thanJNU -3283 (26.75%), BHU-3035 (22.20 %), JMI-1357 (22.58), andthe AMU-2634 (28.22)of OA publicationsin total publications during

2011-2020. UOH has reported a maximum of 1387 (15.38 %) of Open Access Publications in 2019 which is higher than other twouniversities in all years.

TABLE-1

51 Total Publications of the Universities During 2011-2020

	JNU	BHU	JMI	UOH	AMU
Years	**TP (%)**	**TP (%)**	**TP (%)**	**TP (%)**	**TP (%)**
2011	727 (5.92)	1172 (8.57)	264 (4.39)	2181 (6.02)	615 (6.59)
2012	846 (6.89)	1112 (8.13)	354 (5.89)	2770 (7.64)	728 (7.80)
2013	851 (6.93)	1222 (8.94)	326 (5.42)	2928 (8.08)	668 (7.15)
2014	1018 (8.29)	1271 (9.29)	416 (6.92)	3253 (8.97)	656 (7.03)
2015	1351 (11.01)	1468 (10.73)	604 (10.05)	3987 (11.0)	842 (9.02)
2016	1413 (11.51)	1440 (10.53)	552 (9.18)	4068 (11.22)	948 (10.15)
2017	1517 (12.36)	1469 (10.74)	634 (10.55)	4355 (12.01)	1030 (11.03)
2018	1642 (13.38)	1562 (11.42)	812 (13.51)	5075 (14.0)	1152 (12.34)
2019	1660 (13.52)	1613 (11.79)	968 (16.10)	4447 (12.27)	1305 (13.98)
2020	1250 (10.18)	1347 (9.85)	1081 (17.98)	3190 (8.80)	1390 (14.89)
	12275	13676	6011	36254	9334

TABLE-2

52 Open Access Publications (OAP) of Universities During 2011-20

Years	**JNU (26.75%)**	**BHU (22.20 %)**	**JMI (22.58%)**	**UOH (24.88%)**	**AMU (28.22%)**
	OAP (%)	**OAP (%)**	**OAP (%)**	**OAP (%)**	**OAP (%)**
2011	140 (4.26)	198 (6.52)	37 (2.73)	396 (4.39)	225 (8.54)
2012	196 (5.97)	159 (5.24)	64 (4.72)	442 (4.90)	303 (11.50)
2013	215 (6.55)	190 (6.26)	62 (4.57)	511 (5.67)	292 (11.09)
2014	238 (7.25)	243 (8.01)	66 (4.86)	719 (7.97)	325 (12.34)
2015	361 (11.0)	343 (11.30)	128 (9.43)	965 (10.7)	199 (7.56)
2016	409 (12.46)	373 (12.29)	117 (8.62)	1081 (11.99)	196 (7.44)
2017	432 (13.16)	347 (11.43)	130 (9.58)	1188 (13.18)	250 (9.49)
2018	477 (14.53)	422 (13.90)	203 (14.96)	1319 (14.63)	226 (8.58)
2019	478 (14.56)	454 (14.96)	237 (17.46)	1387 (15.38)	277 (10.52)
2020	337 (10.27)	306 (10.08)	313 (23.07)	1009 (11.19)	341 (12.95)
	3283	3035	1357	9017	2634

Open Access Research are accessed through open access journals that are explained as Open access (OA) to every research result which is supported by funding bodies and are set-up as a future goal. Green Open Access is much required to be open access because of fund support; along with this, Gold and Bronze Open Access research publications are also substantial due to financing[13]. It is clearly shown in Table-2 that UOH has published 4161 (46.15%) Gold Open Access research which is more than other four universities. It is also noted that along with UOH (1614), AMU has also published a good quantity of Green Access publications of 1084 papers, whereas JNU in 326, BHU in 259, JMI in 637 of OAP provided Bronze access. In terms of Bronze

Access, UOH published 2025 publications which are more than JNU of 859, BHU of 872, JMI of 130 and AMU of 343 Bronze publications. It is interesting that only 1217 of UOH, 356 of JNU and 301 of BHU, 42 of JMI, and 112 of AMU are published asHybrid Open Access. Finally, it is found that UOH is on top with 9017 Open Access status.

TABLE-3

53 Type of Access of OA Research of Universities

JNU (3283)	BHU (3035)	JMI (1357)	UOH (9017)	AMU (2634)
1742 (53.06)	1503 (49.52)	548 (40.38)	4161 (46.15)	1095 (41.57)
326 (9.93)	359 (11.83)	637 (46.94)	1614 (17.90)	1084 (41.15)
859 (26.17)	872 (28.73)	130 (9.58)	2025 (22.46)	343 (13.02)
356 (10.84)	301 (9.92)	42 (3.10)	1217 (13.50)	112 (4.25)

Gold Open Access makes the final version of an article free and permanently accessible for all, immediately after publication. Copyright for the article is retained by the authors and most of the permission barriers are eliminated.

Green Open Access is referred as self-archiving and provides the practice of placing a version of an author's manuscript into a repository, making it freely accessible for all in the respective organization. The version that can be deposited into a repository is dependent on the funder or publisher.

Bronze Open Access articles are free to read on the publisher page.Such articles may not be available for reuse due to lack of a clearly identifiable license.

Hybrid Open Access is a subscription-based business model in which some articles may be Gold Open Access on the basis of payment,while others would be closed, based on the subscription. In this case, if authors of the universities are publishing Gold Open Access, there will be more chances of maximum usage of the research result that also justifies the public fund in research.

DOCUMENTS CATEGORY OF OPEN ACCESS PUBLICATIONS

The data provided in Table-3 show the document category of the research publications. The analysesshow that JMI published 89.98% and AMU published 88.15% of totalOA publications in article format; whereas as per number of publications, UOH has published 7387 (81.92%) papersand JNU published 2767 (84.28%) papers of document category of article.

It is also evident from the Table-3 that UOH published 8.68% of Open

Access publications as conference proceedings while AMU published 5.73% of total OA publications as Conference paper; however, JNU published 40 (1.22%) of'Book Review' which is more than others.

TABLE-4

54 Documents Category of Open Access Publications

Document Types	JNU (3283)	BHU (3035)	JMI (1357)	UOH (9017)	AMU (2634)
	OAP (%)	OAP (%)	OAP (%)	OAP (%)	OAP (%)
Article	2767 (84.28)	2454 (80.86)	1221 (89.98)	7387 (81.92)	2322 (88.15)
Proceedings Paper	136 (4.14)	91 (3.0)	94 (6.93)	783 (8.68)	151 (5.73)
Review	166 (5.06)	233 (7.68)	0 (0)	453 (5.02)	18 (0.68)
Meeting Abstract	43 (1.31)	75 (2.47)	3 (0.22)	215 (2.38)	17 (0.65)
Editorial Material	102 (3.11)	80 (2.64)	9 (0.66)	124 (1.38)	61 (2.32)
Correction	44 (1.34)	53 (1.75)	9 (0.66)	89 (0.99)	27 (1.03)
Early Access	16 (0.49)	18 (0.59)	0 (0)	58 (0.64)	0 (0)
Letter	34 (1.04)	62 (2.04)	12 (0.88)	46 (0.51)	28 (1.06)
Data Paper	7 (0.21)	4 (0.13)	7 (0.52)	22 (0.24)	0 (0)
Book Chapter	1 (0.03)	2 (0.07)	0 (0)	4 (0.04)	0 (0)
Retraction	1 (0.03)	2 (0.07)	0 (0)	4 (0.04)	1 (0.04)
Retracted Publication	1 (0.03)	1 (0.03)	0 (0)	3 (0.03)	0 (0)
Biographical Item	2 (0.06)	4 (0.13)	0 (0)	2 (0.02)	3 (0.11)
Book Review	40 (1.22)	3 (0.10)	2 (0.15)	2 (0.02)	2 (0.08)
News Item	0 (0)	1 (0.03)	0 (0)	8 (0.09)	4 (0.15)

TOP 10 FUNDING AGENCIES

Funding agencies play an important role in the Universities' research output and augment the research which ultimately drives the country's economic activities. Funding agencies are ranked as perthe strength and interest of agencies on the basis of ranks. These rankings help to believein which department is more focused on research works and which unit is producing more research papers. This forms the basis of performance assessment which helps in formulating the policy making process.

The Table-4 shows that CSIR, UGC, DST, and DBT are major funding agencies and providefunds to these universities for research and innovations. It hasalso been found that CSIR (922), DST (878) and UGC (741), India secured 1st, 2nd, and 3rd position respectively in terms of funding toUOH; whereas, DST, CSIR, UGC India secured 1st, 2nd, and 3rd position respectively for funding in JNU with a contribution to 15.17%, 14.44%, and 11.79% of total OAP; and CSIR, UGC and DST, India secured 1st, 2nd, and 3rd position respectively for funding in BHU with a contribution to 12.06%, 12.06%, and 11.37% respectively of total OAP.UGC, India is one of thetop funders in both

JMI and AMU with 12.31% and 10.59% respectively. DBT India secured 4th position in funding among all five universities namely, JNU, BHU, JMI, UOH, and AMU with a contribution of 10.42%, 5.44%, 2.43% ,5.47% and 1.44% respectively whereasthe maximum funding for OA research has been observed.

TABLE-5

55 Top 10 Funding Agencies of 5 Central Universities

JNU (3283)		BHU (3035)		JMI (1357)		UOH (9017)		AMU (2634)	
Agencies	**OAP (%)**	**Agencies**	**OAP (%)**	**Agencies**	**OAP (%)**	**Agencies**	**OAP (%)**	**Agencies**	**OAP (%)**
DST	498 (15.17)	CSIR	366 (12.06)	UGC	167 (12.31)	CSIR	922 (10.23)	UGC	279 (10.59)
CSIR	474 (14.44)	UGC	366 (12.06)	CSIR	74 (5.45)	DST	878 (9.74)	DST	123 (4.67)
UGC	387 (11.79)	DST	345 (11.37)	DST	69 (5.08)	UGC	741 (8.22)	DSR	109 (4.14)
DBT	342 (10.42)	DBT	165 (5.44)	DSR	54 (3.98)	DBT	493 (5.47)	CSIR	105 (3.99)
USDHHS	176 (5.36)	NSF	116 (3.82)	ICMR	50 (3.68)	NSF	481 (5.33)	ICMR	43 (1.63)
NIH	174 (5.30)	ICMR	113 (3.72)	SERB	48 (3.54)	USDHHS	467 (5.18)	KAAU	42 (1.59)
ICMR	136 (4.14)	NNSFC	99 (3.26)	DBT	33 (2.43)	NIH	463 (5.14)	DBT	38 (1.44)
DBT	72 (2.19)	DAE	96 (3.16)	NIH	28 (2.06)	GRF	386 (4.28)	CGF	27 (1.03)
NSF	68 (2.07)	NIH	94 (3.10)	KSU	14 (1.03)	USDoE	340 (3.77)	SCS	27 (1.03)
DAE	56 (1.71)	USDHHS	94 (3.10)	JSP	9 (0.66)	NNSFC	294 (3.26)	KSU	26 (0.99)

MOST PRODUCTIVE AUTHORS OF THE UNIVERSITIES

The authors playthe most important role in optimizing the research output by publishing quality papers in reputed journals. Table-5 depicts that UOH's Kumar, A., and Kumar, S published 283 (3.14%) and 264 (2.93%) research papers of total open access publications respectively, which is more than top

TABLE-6

56 Top 10 Most Prolific Authors of the Universities

JNU (3283)		BHU (3035)		JMI (1357)		UOH (9017)		AMU (2634)	
Authors	**OAP (%)**	**Authors**	**OAP (%)**	**Authors**	**OAP (%)**	**Authors**	**OAP (%)**	**Authors**	**OAP (%)**
Kumar S	100 (3.05)	Sundar S	200 (6.59)	Ghosh SG	57 (4.20)	Kumar A	283 (3.14)	Mursaleen M	178 (6.76)
Singh A	65 (1.98)	Kumar A	176 (5.80)	Hassan MI	54 (3.98)	Kumar S	264 (2.93)	Ahmad N	102 (3.87)
Singh S	62 (1.89)	Singh V	164 (5.40)	Khan S	46 (3.39)	Ghosh S	183 (2.03)	Ahmad A	100 (3.80)
Kumar A	61 (1.86)	Singh S	146 (4.81)	Ahmad S	44 (3.24)	Varshney RK	182 (2.02)	Irfan, M.	95 (3.61)
Kumar P	54 (1.65)	Singh AK	134 (4.42)	Ahmad F	39 (2.87)	Singh A	174 (1.93)	Stan I	83 (3.15)
Bhattacharya A	49 (1.49)	Singh A	111 (3.66)	Sen AA	39 (2.87)	Gupta R	172 (1.91)	Blanco F	82 (3.11)
Pareek A	48 (1.46)	Kumar S	99 (3.26)	Haleem A	36 (2.65)	Kumar V	172 (1.91)	Chattopadhyay S	82 (3.11)
Prasad R	48 (1.46)	Singh Bk	96 (3.16)	Islam A	35 (2.58)	Mukherjee S	170 (1.89)	Kim M	82 (3.11)
Goudar SS	46 (1.40)	Deshpande A	94 (3.10)	Ahmad T	30 (2.21)	Lee K	169 (1.87)	Wang Y	82 (3.11)
McClure EM	46 (1.40)	Li X	93 (3.06)	Kumar A	30 (2.21)	Sharma R	168 (1.86)	Zhu J	64 (2.43)

10 most productive authors taken cumulatively. BHU's Sundar, S published 200 (6.59%) of total OAP whereas Mursaleen, M in AMU published 178 (6.76%) papers. It is interesting to note that all the top 10 authors of UOH published more than 100 papers.

FINANCIAL RESOURCES UTILIZATION BY UNIVERSITIES 2012-2020

The data with regard to the utilization of financial resources by JNU, BHU, JMI, UOH and AMU are extracted from the NIRF website for the period 2012 – 20 which lastsfor eight years. According to the data in Table-6, it is noted that JNU, BHU, JMI, UOH and AMU utilized financial resources that is3427.44 Cr, 7652.04 Cr, and 2437.67 Cr, 1194.73 Cr, and 5516.24 Cr respectively. It is also observed that UOH utilised less resources than other four universities but producing more open access research; however, the utilization of financial resources of BHU is more than all although producing less open access research. It is depicted from the Table-1 that there is UOH which has utilized less resources and produced the maximum research output than others during 2012-20. The only reason to show this table is that open access research does not relate with the utilization of financial resources.

TABLE-7

57 Total Financial Resources Utilization during 2012-20 (Cr.)

Years	JNU	BHU	JMI	UOH	AMU
2012-13	9.75	421.4	6.35	18.24	422.76
2013-14	271.12	659.63	260.29	112.56	543.81
2014-15	336.69	731.76	255.96	128.93	620.54
2015-16	478.47	825.54	329.25	143.77	604.77
2016-17	519.24	894.14	318.83	176.97	640.41
2017-18	561.22	1016.92	417.74	197.24	897.69
2018-19	572.92	1395.25	425.94	191.86	877.32
2019-20	678.03	1707.4	423.31	225.16	908.94

6 FINDINGS

The observation reveals that University of Hyderabad produced 9017, i.e. maximum number of Open Access Publications than JNU (3283), BHU (3035), AMU (2634), and JMI (1357) during 2011-2020. However, UOH utilizes lesser financial resources of 1194.73 Cr than other four universities during 2012-2020. In terms financial constraint of article publishing fees, it may be expected from BHU, AMU, JNU, and JMI who has more financial resources, to promote the open access research among its researchers.

In terms of overall publications of the universities during the years 2011-2020, the UOH has always been on the top with 36254, and produced maximum

publications in comparison to BHU (13676), JNU (12275), AMU (9334), and JMI (6011). It also illustrates that the research performance in the UOH has been highest and satisfactory in comparison to JNU, BHU, AMU, and JMI during this study.

The Open Access Research publications is the core part of the study, and it has been explored that UOH has been on top with 9017 publications of Open Access Research during 2011-2020 and secured 1st position, whereas JNU scored 2nd position with 3283 publications and BHU secured 3rd position with 3035. From the results, it is established that the UOH is on top with less financial resources and BHU secured 3rd place for OA research with a high financial resources and infrastructurethat can be advantageousfor Open Access Research.

The UOH is on top with the indexing of 4161 Gold Open Access publications and also leading in the other business model of Green, Bronze and Hybrid access. It is also interesting to notice that BHU secured 3rd position and AMU secured 4th position in the study among five universities even after more utilization of financial resources. The Open Access can be promoted in the BHU and AMU and provide financial support for Article Publishing Charges.

In terms of the document type, it is found from the study that the share of the article is 89.98% (JMI), 88.15% (AMU), 84.28% (JNU), 81.92% (UOH), and 80.86% (BHU) of total publication which indicates that 'article' is most favourite document type in all five universities. UOH has highest Conference Proceedings with 786 (8.68%); whereas JNU is highest in Book Review with 40 (1.22%) among all. In the same chart, it is also found that Review papers are highest in BHU with 7.68%.

In any organization, funding is a very important factor for research activities. The study discusses that CSIR India's contribution is highest in BHU with 12.06% and after that UOH with 10.23% become 2nd receiver of the fund. DST India is the topmost funder in JNU, 2nd in UOH, and 3rd in AMU with 15.17%, 9.74% and 4.67% respectively. UGC is also top most funder in JMI and AMU with 12.31% and 10.59% respectively.

Research publications are produced by authors who play a major role in research activities. It shows that Kumar,A is the most prolific author among all five universities with 283 (3.14%) of total publications whereas Sundar, S is the 2nd top prolific author with 200 (6.59%) publications and Mursaleen, M is the topmost prolific author in AMU with 178 (6.76%) of total OA publications.

BHU has utilized financial resources of 7652.04 Cr more than all four universities; whereas AMU also utilized financial resources of 5516.24 Cr more than three universities which depicts that these two universities BHU and AMU has broader infrastructure than other three universities JNU, JMI and UOH. UOH has utilised 1194.73 Cr least among all five universities. BHU has highest utilization of 1704.04 Cr in 2019-20 which is highest among all.

7 CONCLUSION

The conclusion of the study is to improve, advance and popularise Open Access Research among scholars, academicians, and scientists. Along with this, the Government should frame the guidelines to overcome the constraints of Open Access Research and democratize the knowledge among its universities. Universities should put out their best foot forward to motivate their faculties and researchers to adopt to open access models for their publications more and more, and set an example to the other organizations more of editorial material, reviews, book chapters, news items, which should come under the purview of Open Access Publications apart from articles. It is also concluded from the study that universities may help the researchers for publishing their research output in open access journals through removing the constraints of the Article Processing Charge and encourage them to opt the golden access and deposit their research in the university repository for open access.It is concluded from the study that CSIR, DST, UGC, and DBT of India are the topmost funding agencies to the universities that provide funds for research purposes.

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