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Bashir, A. & Siddique, Z. pp.89-99

Assessing the research productivity of funded and non-funded sources: Implications of enabling environment on research quality and quantity in higher education

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Abstract

Research is an adjacent part of higher education, especially at the postgraduate level. To examine how much contribution Ph.D. studies have made to the research output in Pakistan, data was collected through a questionnaire from 784 faculty & non-faculty members of different universities in Pakistan. The results of the research productivity of Ph.D. over Non-Ph.D. faculty are analysed in this study. The results indicate that the average number of research publications from non-funded sources is higher than those from the funded source. The average number of non-funded publications of Ph.D. degree holders is 4.54, 5.71, 2.38, 0.35, and 0.67 in impact factor, X, Y, Z, and other categories respectively. The average number of impact factor publications is higher for domestic than foreign Ph.D. degree holders; however, the foreign degree holders are publishing more articles in W category journals. In addition, research-enabling environment of universities is important, and almost two-thirds of universities are providing sponsorships and cash awards for publications in different categories.

Keywords: research productivity, enabling research environment, publications from funded and non-funded sources, research quality and quantity in higher education

Jel Codes: I26, I23, I21

1. Introduction

Research is the fundamental pillar of society to open new avenues of knowledge creation, and universities are the main drivers of research and human capital accumulation. Research facilitates economies to grow because it has considerable positive externalities. In fact, funding opportunities for research play a vital role in the quality and quantity of research undertaken in an economy. Furthermore, research findings provide evidence-based direction to policymakers for designing policies (Gök, Rigby, & Shapira, 2014).

Because universities are the main hub of knowledge creation, it is important to provide funding opportunities to the university faculty and researchers to motivate them (Abbott & Doucouliagos, 2003). Therefore, many factors affect the research productivity including, age, gender, Ph.D. location (Jung, Seo, Kim , & Kim, 2017). As per the given results Simonton (1997), age is negatively correlated with research productivity, but according to Merton (1988), the cumulative advantages are more for older researchers due to more recognition. The whole world is considered a global village, and most of the researchers are working together from different countries. The international research collaboration increases the circulation and impact of research due to shared authorship (Van Raan, 1998). Apart from these, it is important to study the differences in research quality and quantity resulting due to between funding opportunities.

Pakistan has made rapid progress in higher education after the formation of the Higher Education Commission (HEC) of Pakistan in 2001-02. In this era, there are numerous research articles, and reports have been presented the research outcomes such as [((Ahmed, 2017) (HAQUE, et al., 2020), and (Kumari, Babur, & Siddiqui, 2017)]. According to Ahmed (2017), the number of research publications increased by 687 percent, but the quality of research was not so good. The impact factor journal publications are the basic measurement scale to find the quality of research but unfortunately, most of the research articles were published in low impact factor journals. The findings of Iqbal, Mahmood, & Iqbal (2018), are showing the correlation between the budget allocation of higher education and the number of publications. Meanwhile, in the last two decades, the allocation of the budget, and

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the number of publications were increased by 1566, and 1182 percent respectively. Hence, with the passage of time, the international collaboration in research articles has been increasing from 0.25 to 0.37.
The current study focuses on:

- To calculate the contribution made in knowledge creation by those who hold Doctor of Philosophy (Ph.D.) degree over those who are Master of Philosophy (MPhil).
- Measuring the differential in research productivity due research funding opportunities.
- Examine the impact of enabling research environment on research quality and quantity in higher education in Pakistan?

1.2. Significance of the Study

The current study is concentrating on research productivity from two aspects: effect of funding opportunities on research output of university faculty and researchers, the impact of enabling research environment on quality and quantity of research. Besides, the outcomes of this research will provide insights to the universities and policymakers in establishing new research policies for the sake of the betterment of research quality. Moreover, the enabling research environment is an adjacent part of the research. According to Craig O, (2021), citations per faculty is the most important component to improve the university ranking, so after this study, the decision-making authority of the university would be able to design a research-friendly environment for faculty members. In fact, the higher education system of Pakistan is divided into two segments, in accordance with Private, and public sector universities. Additionally, this study will provide a comparative analysis of both sectors regarding research productivity that will also be helping the educational policymakers.

2. Data Description and Methodology

2.1. Data Description

The fundamental objective of this study is to find the impact of research funding on research output. The data of this study was collected through a survey and the instrument of data collection was questionnaire. The respondents of the survey are faculty & non-faculty members of different universities of Pakistan[1] and the research productivity of faculty members is estimating since the establishment of HEC to 2021. Four areas[2] are focused upon to find out the research outcome from funded and non-funded sources using cross-sectional data. The total number of respondents is 784 with academic degrees of Ph.D., and Non-Ph.D. Faculty in four disciplines as shown in Table 1.

Table 1. Distribution of Sampled Respondents by Subject Discipline

Gender	Area of Study				
	Social Sciences	Mang. Sciences	Engineering & Computer sciences	Natural Sciences	Total
Male	145	102	113	162	522
Female	77	56	50	79	262
Total	222	158	163	241	784

Source: Author's survey

[1] The data was collected from different universities in the following cities in four provinces such as, Islamabad, Rawalpindi, Lahore, Multan, Rahim Yr Khan, Bahawalpur, Faisalabad, Karachi, Jamshoro, Larkana, Quetta, Mardan and Peshawar.
[2] The respondents of the survey were from these disciplines, such as Social Sciences, Management Sciences, Engineering & Computer Sciences, and Natural Sciences.

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Bashir, A. & Siddique, Z. pp.89-99

For calculation of sample size, we used the following formula,

$$n = Z^2 . \frac{P(1-P)}{e^2} / 1 + (Z\text{^}2.\ P(1\text{-}P) / e\text{^}2.N)$$

- Z^2 = Critical value of the Normal distribution at α/2 (e.g., for a confidence level of 95%, α is 0.05 and the critical value is 1.96
- e^2 = Margin of error 5%
- P = Sample proportion = 0.5
- N = Population Size, total 47346, PhD Faculty = 14614, non-PhD Faculty = 32782

The sample size was calculated with the known population of Ph.D. and non-PhD faculty members separately. The total number of non-PhD respondents is 380, and 374 responses of Ph.D. faculty. As per the given population, the required number of responses are 754, but the total collected responses are 784. The data was collected through random sampling method, under some restrictions such as, those degree holders who completed their degree from 2001 to 2020. Meanwhile, the respondents of the survey were only employed persons in academic institutions. The current study is concentrating on quantitative analysis by using exploratory data analysis (EDA). The descriptive analysis describes key summary statistics to examine the output of enabling research environment and funding opportunities in universities. The Higher Education Commission of Pakistan is categorizing the journals in W, X, Y, and Z categories, where the W category is considered the "Impact Factor" category, while X, Y, and Z categories are moving towards high to low quality journals respectively. Meanwhile, the W category publications belong to international reputed journals, while the other categories are considered in both international and national journals.

3. Results and Discussion

3.1. Descriptive Analysis

This section is based on descriptive analysis, which contains the results of research outcomes at different levels of education. In this regard, the analysis is divided into two parts such as the impact of research funding on research quantity and quality. Moreover, assessing the research quality and quantity of those faculty members who hold the degree of Doctor of Philosophy (Ph.D.) and Master of Philosophy (MPhil). Lastly, exhibiting the role of enabling research environment to improve the research quality and quantity of Ph.D. degree holders.

3.1.1. Research Output from Non-Funded Sources

Table 2 shows of per person average number of published articles of PhD and non-Ph.D. faculty members from non-funded sources.

Table 2. Average Number of published Articles by Ph.D. and non-Ph.D. Faculty Members

Degree-wise Publications	W	X	Y	Z	Others
Total Number of Papers Having Ph.D.	1272	2069	567	59	122
Average number of Ph.D.'s papers	4.54	5.71	2.38	0.35	0.67
Total Number of Papers of non-Ph.D. Faculty	75	146	116	5	45
Average number of papers of non-Ph.D.	0.31	0.74	0.6	0.08	0.27
Surplus of Ph.D.	1364%	671.60%	297%	337%	148%

Source: Author's Estimations from survey data

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Bashir, A. & Siddique, Z. pp.89-99

Ph.D. degree is a key source of knowledge creation as compared to the non-Ph.D. (MPhil) degree. In case of Pakistan, a Ph.D. degree holder on average has 4.54, 5.71, 2.38, 0.35, and 0.67 publications in impact factor, X, Y, Z, and other categories respectively.

Therefore, these numbers are much higher as compared to those of non-Ph.D., and in terms of research quantity, the difference between Ph.D. and non-Ph.D. degree holders is significantly high. In fact, the quality and quantity of research can play significant role for both researcher and the university. In this context, Vernon, Balas, & Momani (2018), examined the relationship between research and university ranking. They evaluated 13 university ranking systems, and six out of 13 are 100% focused on the research performance.

Table 3 is representing the results of the category wise average number of publications by local and foreign Ph.D. degree holders (In the survey, 33.4% of respondents are having a foreign Ph.D. Degree).

Table 3. Average Number of Published Articles by Degree Origin Country [2001 to 2020]

Country of Ph.D. Degree	W- (Impact Factor)	X	Y	Z	Others
Pakistan	5.4	5.64	3.27	0.45	0.93
Foreign	3.27	5.85	1.36	0.26	0.45

Source: Author's Estimations from survey data

As per the results, the average number of impact factor and Y category publications are higher for those who have Ph.D. degree from Pakistan. Conversely, the foreign degree holders have a slightly higher average number of publications in X category journals.

Baloch, Siming, Abraha, & Hong (2020), analyzed the research productivity of faculty members between domestic and foreign doctoral degree holders in Pakistan. The results of that study are endorsing that foreign degree holders are not more productive than domestic degree holders, but they are publishing more research articles in reputed international journals and with international colleagues.

Table 4. Average Number of Published Articles by Ph.D. Faculty Members: Gender-wise

Gender	W	X	Y	Z	Others
Male	4.78	5.89	2.3	0.35	0.53
Female	3.71	5.27	2.58	0.28	1.06
Surplus or Deficit in Publications of Male over Female	28.80%	11.76%	-10.85%	25.70%	-50%

Source: Author's Estimations from survey data

Table 4 represents the average number of published articles by gender which clearly insights that male Ph.D. faculty members are more productive in research than female faculty. Furthermore, the male Ph.D. faculty members are publishing 4.78, 5.89, 2.30, 0.35, and 0.53 on average articles in W, X, Y, Z, and other categories

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Bashir, A. & Siddique, Z. pp.89-99

respectively: moreover, these publications are 28.8, 11.76, and 25.7 percent higher in, W, X, and Z categories respectively as compared to the female Ph.D. faculty members.

Table 5. Average Number of Published Articles by the Sector of Employment [2001 to 2020]

Sectors	W	X	Y	Z	Others
Public	4.5	5.75	2.2	0.35	0.7
Private	4.18	4.96	2.96	0.50	0.55
Surplus and Deficit of Public Sector Ph.D. Faculty	7.65%	15.90%	-25.60%	-30.1%	27.70%

Source: Author's Estimations from Survey Data

Educational institutions are divided into two categories, including the public and private sectors. In table 5, the research productivity of public and private sectors universities is given. The Ph.D. faculty of public universities are more productive as they are publishing more papers in impact factor journals, while in the Y category the faculty of private universities are publishing more papers than the public sector. Moreover, the total number of respondents is 784, and the share of private sector universities is 33.5 percent, which is 263 out of 784 respondents.

Table 6. Average number of published Articles by Gender and Sector of Employment

Sectors	Journal Categories							
	W	X	Y	Z	W	X	Y	Z
	Male				Female			
Public	4.8	5.9	2.15	0.42	3.6	5.4	2.4	0.25
Private	4.5	5.88	2.9	0.58	3.3	4.89	3.01	0.3
Surplus or Deficit in Publications of Private Sector	-6.25%	-0.33%	34.8%	38.09%	-8.33%	-9.44%	25.40%	20%

Source: Author's Estimations from survey data

Table 6 presents that sectoral-wise number of publications separately for the male and female Ph.D. faculty members. In terms of research productivity, the female faculty members are more productive in the W and X categories in the public over private sector universities, while sectoral-wise, the male faculty members are also more productive in the W category, but they are almost equal in X category. The Ph.D. faculty members of private sector are more productive in Y category.

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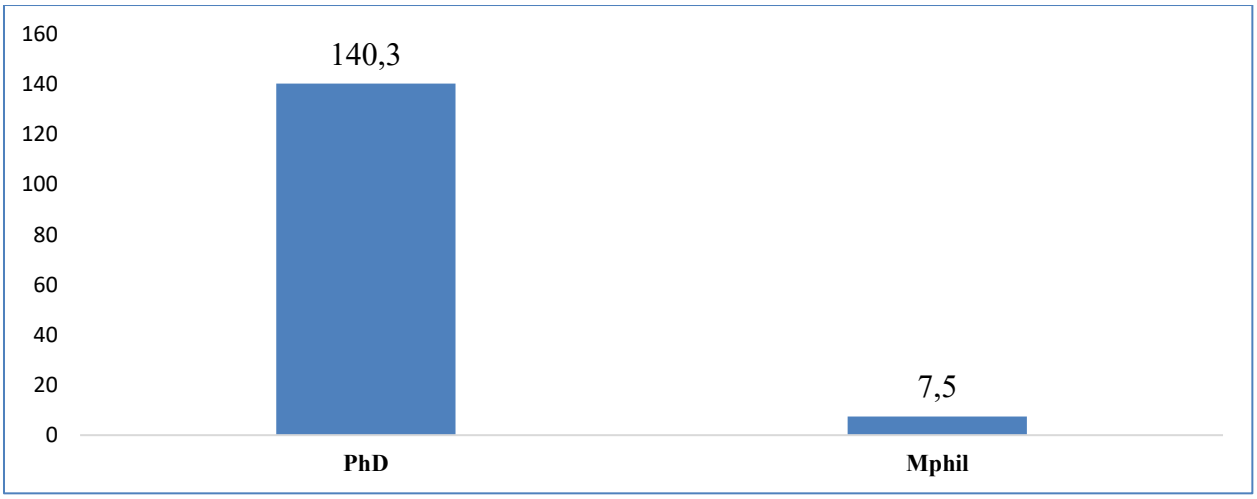

Figure 1. Average Number of Citations of Published Articles by Ph.D. and non-Ph.D. Faculty
Source: Author's Estimations from survey data

Figure 1 presents the difference in citations of research articles of a Ph.D. and non-Ph.D. faculty, which shows that a Ph.D. degree holder has a higher average number of citations than a non-Ph.D. degree holder. The results of the above figure are consistent with the fact that Ph.D. degree holders are publishing more quality research papers.

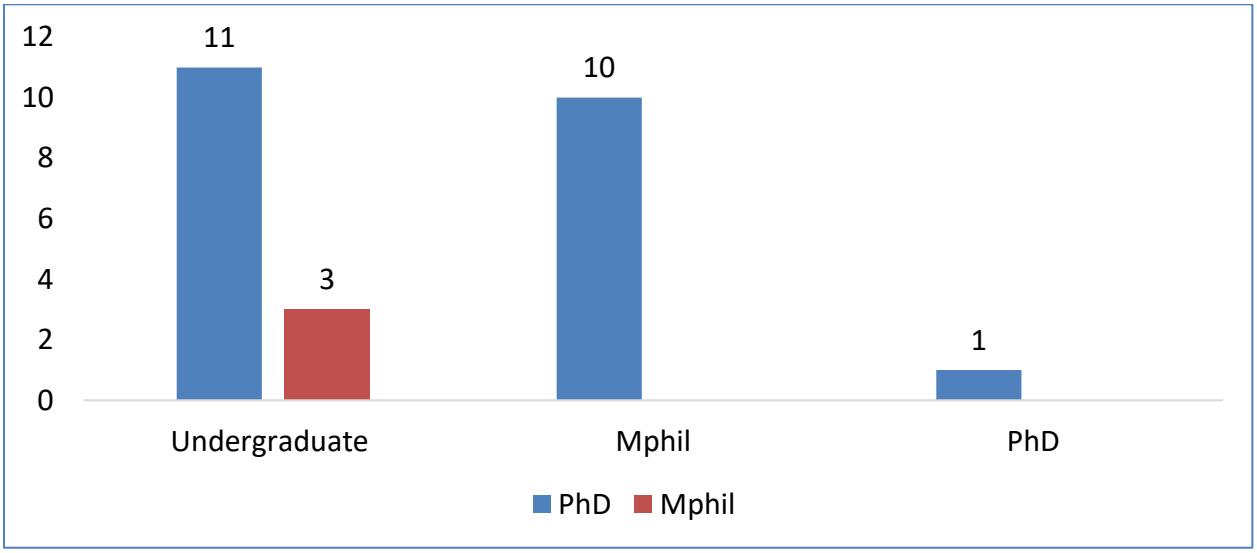

Figure 2. Average Number of Thesis Supervised by the Ph.D. and non-Ph.D. Faculty
Source: Author's Estimations from survey data

A Ph.D. faculty member on average has supervised 11 theses at the undergraduate level, whereas a non-Ph.D. faculty member holds on average three supervisions. As per the given survey data, a Ph.D. faculty member has supervised on average ten M.Phil. and one Ph.D. level dissertation which shows that a Ph.D. faculty member is more productive in terms of research supervision as compared to a non-Ph.D. faculty member. [3].

[3] As per 19th meeting (27-Feb-2015) of National Quality Assurance Committee (NQAC) the faculty members having MS/MPhil without thesis, but with relevant research experience can supervise the research of MS/M.Phil students.
Meanwhile, according to the 22nd meeting on 01, Jan, 2017 had decided that besides, a Ph.D faculty member who got his MS/MPhil/Equivalent degree four years ago can supervise the MPhil/MS program students as per policy given in HEC letter No. 1-1 (NQF)/QAD/207/HEC/501 dated 21 July, 2017.

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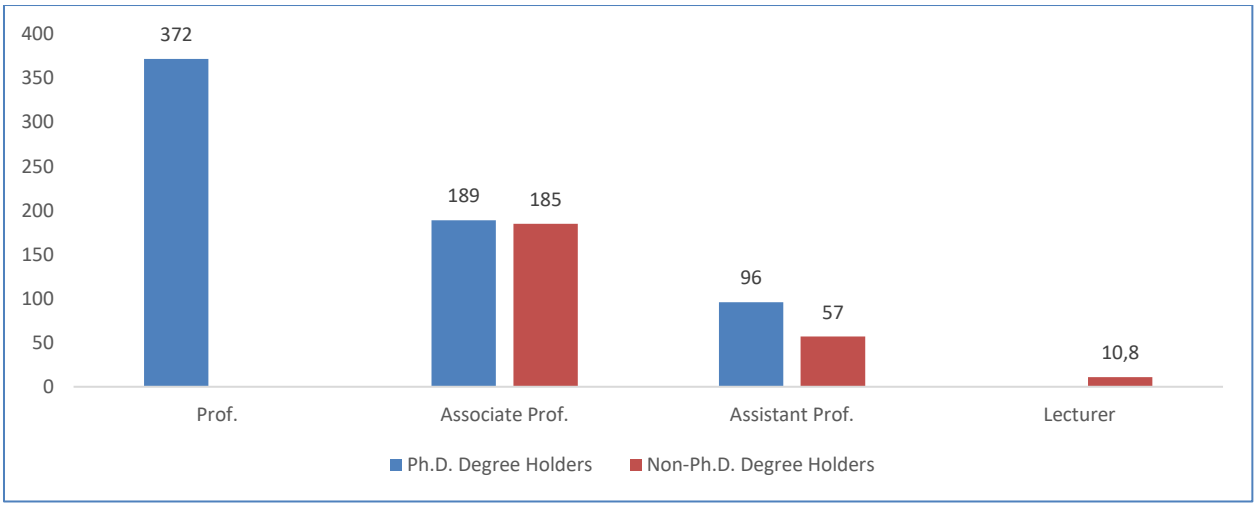

Figure 3. Average Citations of Published Articles by Designation and Position
Source: Author's Estimations from survey data

Figure 3 presents the average number of citations that clearly insights that professors have almost double citations as compared to the rest of their counterparts within Ph.D. degree holders who have citations of 189 (associate professor), 96 (assistant professor). In contrast, a drastic decline in the average number of citations is observed among non-Ph.D. degree holders: 10.8 for lecturers and 7.7 for research associates. The average number of citations of non-Ph.D. degree holders are 57, and 185 who hold the position of assistant professor, and Associate professor respectively.

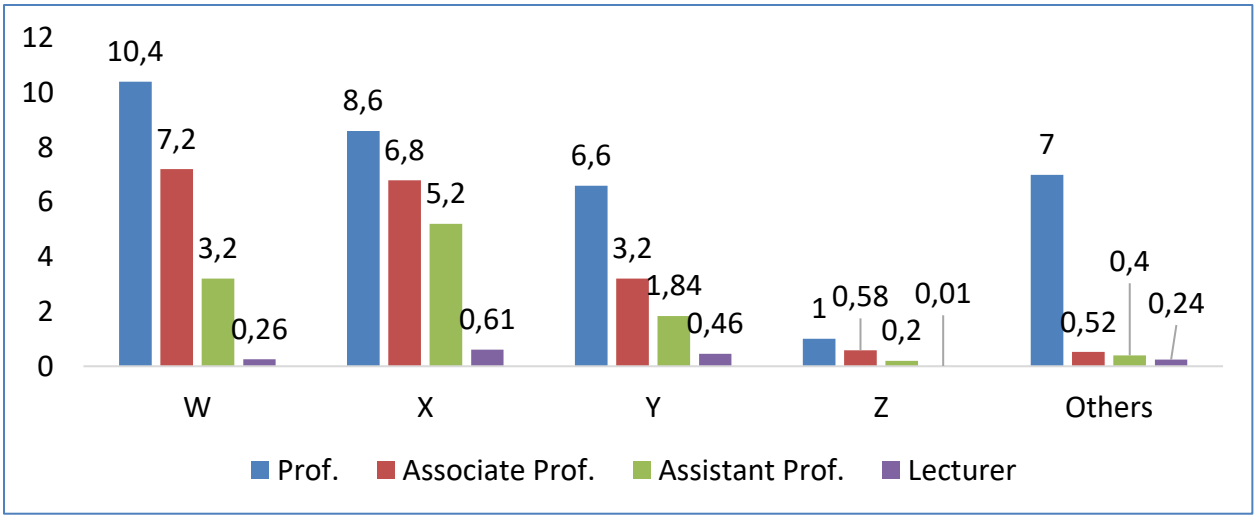

Figure 4. Average Number of Publications by Designation
Source: Author's Estimations from survey data

The above figure represents the number of publications by designation where professors are publishing a large number in the W category than in the X category. Meanwhile, the associate professors also publish quality work, but the assistant professors have been 5.2 average publications in the X category than 3.2 publications in impact factor.

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Bashir, A. & Siddique, Z. pp.89-99

Table 7. Average Number of Published Articles by Disciplines [From 2001 to 2020]

Disciplines (Ph.D. Degree)	W- (Impact Factor)	X	Y	Z
Social Sciences	2.96	5.29	2.91	0.23
Mang. Sciences	3.63	5.4	1.71	0.46
Engineering	4.24	4.75	0.8	0
Natural Sciences	5.13	5.87	2.9	0.4

Source: Author's Estimations from survey data

Table 7 is showing the discipline-wise average number of publications in different subject categories. Moreover, most of the researchers are publishing articles in reputed journals, but the average number of publications in social sciences is the same in the impact factor and Y category while others are publishing more in high-category journals.

3.1.2. Research output from Funded Sources

Higher Education Commission of Pakistan offers several funded research project opportunities, such as National Research Program for Universities (NRPU), and Innovative & Collaborative Research Grants (ICRG), etc. to the university faculty. Table 6 presents average number of published articles from these funded projects by the faculty members.

Table 8. The Average Number of Published Articles from HEC Funded Projects

Degrees	W- (Impact Factor)	X	Y	Z
Ph.D. Faculty	1.9	1.19	-	-
Non-Ph.D. Faculty	0.48	0.53	-	-
Surplus of Ph.D.	295%	126%	-	-

Source: Author's Estimations from survey data (2001 to 2020)

The average number of published articles by Ph.D. faculty members is 1.9 and 1.19 in the impact factor and X categories. The important thing is that the average number of publications is less than non-funded projects (The average number of published articles is 4.54, and 5.71 of W and X categories from non-funded projects respectively), However: the publications from funded projects are usually published in reputed journals.

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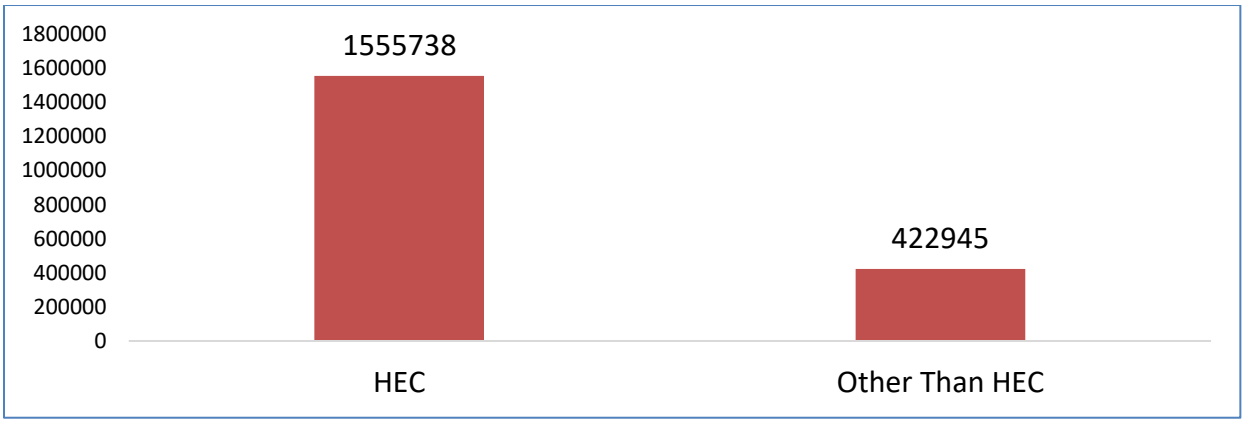

Figure 5. Average Payment Received from HEC & Other Sources for the projects (Rs.)
Source: Author's Estimations from survey data

The above figure presents the average payment received from funding agencies for different projects by university faculty members. The average received payment from HEC is Rs. 1,555,738, and the average number of publications is 1.9 in the impact factor category. Meanwhile, the average received payment from other sources is Rs. 422,945, and the average number of publications is 0.81, 1.3, and 0.62 in W, X, and Y categories respectively. The total number of researchers is 78 along with 201 publications that received research funding from HEC. In this context, the average cost per research paper from HEC funding is Rs. 6,03,719, while other than HEC total number of researchers is 29 with 57 publications, and the average per paper cost is Rs. 2,15,182.

3.1.3. Enabling Research Environment

Research is the foremost tool of knowledge accumulation and requires a research-friendly environment in universities. Different factors explain the research environment such as publication awards, relaxation in teaching workload, workspace, and facilities (Printer, Computer, Lab), and provision of guidance through trainings.

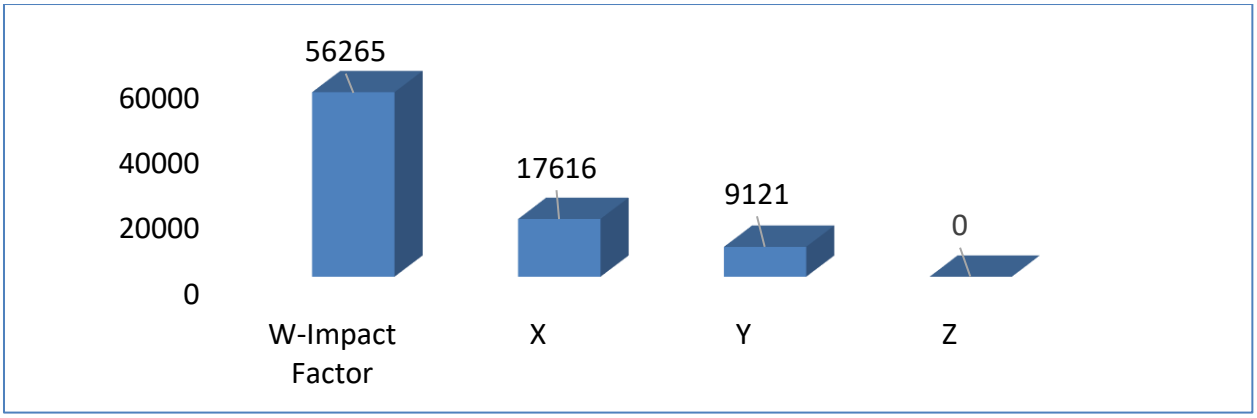

Figure 6. Category-wise Average Cash Award Paid by the Universities for Publication
Source: Author's Estimations from survey data

The cash award is very important for the motivation of the researcher to keep going the best research. After the publication, the research article is considered a positive externality because anyone can take benefit from research papers. In the current sample, the average cash award received by the researchers is Rs. 56,265, 17,616, 9,121, and 0 for the impact factor, X, Y, and Z category journals respectively. In the same way, the average cash award for publication by the public and private sectors universities is almost same.
As per the given outcomes of figure 7, almost two-third of universities are providing sponsorships and cash awards in different categories of publications.

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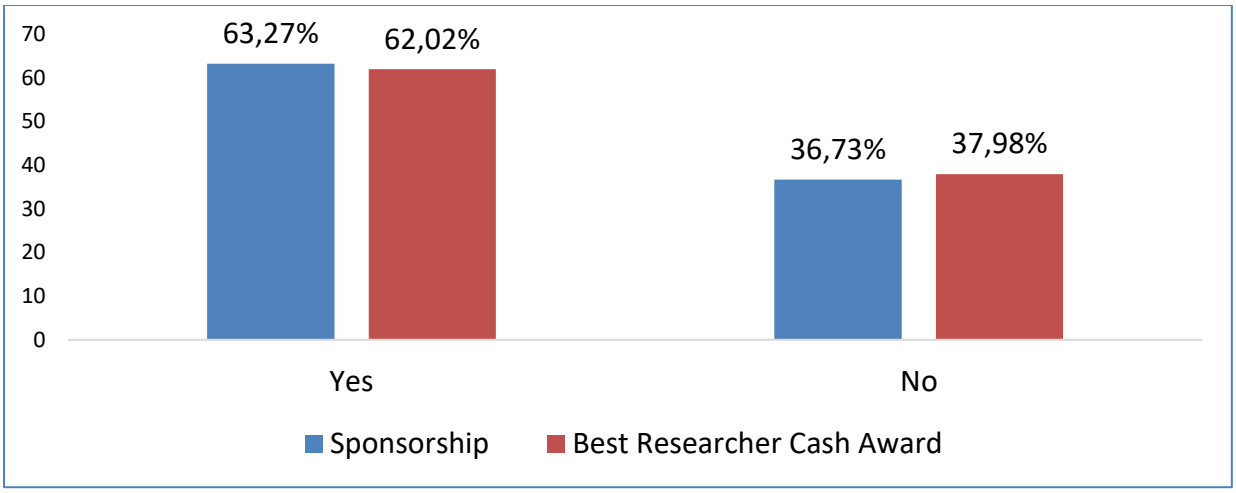

Figure 7. Sponsorships and Cash award Paid by the University for Publication
Source: Author's Estimations from survey data

As disused above the research is a positive externality so motivation and reward are very important for the sake of knowledge accumulation. Most of the reputed journals have the heavy publication fee, so the financial support by the University for Publication will improve the research productivity of researcher.

Table 9. Relaxation in Teaching workload and Research Trainings by the Universities (%)

	Yes	No
Relaxation in Workload	58.24	41.76
Faculty Research Trainings	59.26	40.74

Source: Author's Estimations from survey data

Research is a full-time job and requires enough time for the quality research. Table 9 presents that 58.24 percent of universities are giving relaxation in teaching workload if researchers published articles in a reputed journal. Along with this, almost 60 percent of universities are providing research trainings to the faculty for good research.

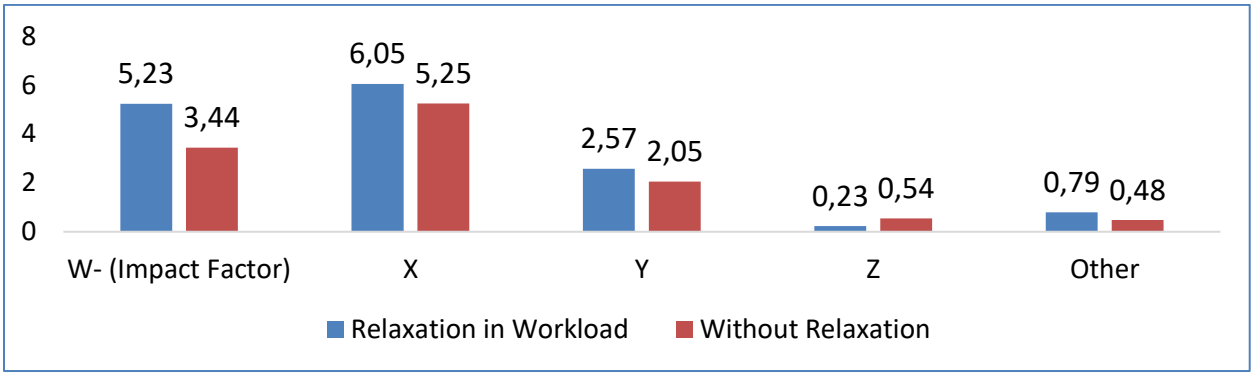

Figure 8. Impact of Relaxation in Teaching Workload on Average Number of Publications
Source: Author's Estimations from survey data

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The figure 8 is indicating that the researcher is more efficient who is receiving relaxation in teaching workload in case of publication in reputed journals. The average number of impact factor publications are 5.23 and 3.44 when they are taking relaxation in teaching load and without relaxation respectively. In fact, the publications in other categories are also showing the almost same results as the W category, which is presenting the positive impact of relaxation and research training on research productivity.

4. Conclusion and Policy Recommendations

Research is a gateway to innovations and knowledge accumulation for society to improve the intellectual level. In this regard, universities are the main source of knowledge accumulation especially at higher levels of education such as Master of Philosophy (MPhil) and Doctor of Philosophy (Ph.D.). Moreover, based on the research findings, the number of citations and publications of Ph.D. faculty members is higher than non-Ph.D. faculty.
Therefore, the average number of publications is higher for those faculty members who did not get any research funding than for publications from funded projects: however, the publications of the funded projects were published in reputed journals. Enabling the research environment is very important to maintain research quality and quantity so, almost two-third of universities are giving sponsorship and cash award to the faculty members for the publications.

Based on the results, these are the following policy recommendations to improve the research quantity and quality of the researcher:

- Taking account of the results, the research productivity of non-Ph.D. faculty is almost nothing so, universities should motivate and push the non-Ph.D. faculty towards good research.
- As discussed above, the research publication is a positive externality thus research award will boost the research quantity and quality. Now, almost two-thirds of universities are providing sponsorships and research cash awards: moreover, sponsorships and cash awards should be provided to the researchers by all universities.

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