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Tendencies of Active Researchers and Evaluation of Peer Reviewers: An Analysis of Research Projects Submitted to Funding Agency in Pakistan

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ABSTRACT:

This study analyzed the tendency of researchers towards certain scientific fields, their demographics, institutes' associations, gender participation and the evaluation reports of peer reviewers. Total 1787 research proposals submitted to the funding agency in Pakistan were categorized into 13 major fields of research. The study revealed that researchers have more tendency of submitting research proposals towards Biotechnology, Biochemistry and Molecular Biology related disciplines, medium tendency towards Engineering, Physics, Chemistry & IT and were least interested towards Energy, Livestock, Earth Sciences, climate change, Water & Soil and almost none towards STEM, Emerging Areas and Space Sciences. Very few organizations bothered to attempt any research grant. The need is recommended to align research towards national priorities which are import substitution and the export of indigenous output. Female scientists are also not contributing in AJK and Gilgit, moderately contributing in KPK and Balochistan, and at average participation in Punjab, federal capital and Sindh as compared to international ratio. 622 research proposals out of 1787 were shortlisted. Each project proposal was peer reviewed by two subject experts with final score A, B & C. There is significant association found between independent reports of the different peer reviewers for the same project and that the Peer Review is totally independent to the specific field of study.

Key Words: Peer Review, Technology Management, Research Demographics, Research Disciplines, Research Funding, Research Management

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1. Introduction

Background

Pakistan is a country with minute financial space. It needs to give more attention towards its expenditure which is already at lowest ebb in comparison to the international standards and norms. Research funding in Pakistan is limited but the world spends a lot on it through hundreds of funding agencies. Some 333 funding agencies awarded 4.3 million grants spending almost USD 1.3 trillion in last 70 years (Taffe & Gilpin, 2021).

Pakistan spends few billions of rupees annually, for indigenous research projects, through different funding agencies, with an aim of socio-economic development. This research study determines the direction of researchers by analyzing data of the research projects submitted to funding agency to seek grant. Former studies analyzed through number of publications in the scientific fields (Huang & Huang, 2018) and others analyzing studies on overall R&D expenditures (Grimpe, 2012). A gap exists that in which fields applicants are interested to do indigenous Research & Development (R&D).

Ministry of Science & Technology has Rs. 8.341 Billion to uplift scientific endeavors of the whole country. Dividing it by population of 220 million, it makes Rs. 37.91 per capita expenditure (Pakistan Federal Budget Document, 2021-22). Though the figure may go bit higher if included with the budgets of HEC and the education ministries of Federal and Provincial governments but any miracle is out of expectation. In this study, the consideration and focus is kept over the funding of scientific research through Ministry of S&T. The science ministry has only Rs. 37.91 per capita expenditure to uplift scientific initiatives in Pakistan. Citing abysmal per capita expenditure, its effective utilization is of much concern and the efforts of scientists to harness grants out of the limited resource should be more effective due to high competition for grants.

Problem Statements

The equitable distribution of resources among the scientists of different fields is not ensured in Pakistan. There are certain institutes who get ample funding while few others do not get any funding at all. Few fields of research are harnessing multiple research projects while many remain deprived. Research is not conducted in certain needed fields and thus funding drains in the repetitions where already ample funds are available. The gender differences and the demographic portfolios were yet unknown for the active scientists. Further, limited resources have more pressure on funding agencies due to the limited resources. The measure of the independence of peer reviewers will enlighten us whether the distributed funds are either biased or on merit.

Research Questions

Research questions are designed to generate general understanding about the existence of scientific attitudes in different cities, provinces and institutes, to guage gender participation and the peer review scoring. The demographics of research will help us determine the field wise scientific density.

- How much does gender parity exist between active researchers?
- Which provinces do participate for the research funding and in which fields?
- Which fields of research are preferred and which are less focused by the scientists?

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- Which institutes are active and why disparity exists in terms of funding of certain institutes?
- What are the city wise scientific opportunities available for the upcoming generations?
- How much is the peer review of research project has similarity with the report of other subject expert and over the area of study of research proposals?

2. Literature Review

The funding agency remains of interest for policy-makers and the power circles in scientific research (Braun, 1998). It is an old issue that the ratio of managed grants is higher than the curiosity driven grants even in developed world nations and thus reports from "UK Science & Technology Committee Report" pressed the need to establish a standardized criteria for research funding within and between different research councils and to expand the base of research topics ("Editorial: Research Funding: The Problem with Priorities," 2003). It is easy to predict from this fact that developing nations would be suffering from this issue more than the developed ones citing their meager resources and limited innovation capacities.

Pakistan is a country where regional quota is given due share in certain fields like jobs and seats in senate and Assemblies. The brains sitting in different scientific committees, though not following quota in hard and fast, have this in mind and know the socio-economic conditions of different regions. Though it's not technical but in political terms and is regarded as 'Control Arena' by (Braun, 1998). Moreover, the Technical Committees can drop a high-rated project if it does not meet the requisite criteria (Braun, 1998). For instance, during COVID-19 spree in 2020, an indigenously produced simple mask was the priority over any high-rated research project. So, high-rating is not a guarantee of getting funding but such projects may determine the strength of research. Currently, only a factor of geography is considered, other factor like racial are not under consideration which cannot be controlled even in NIH grants despite being monitored from 2011 to 2019 (Taffe & Gilpin, 2021).

There exists a minor evidence on productivity out of third party funding and thus required further research to allow policymakers to make evidence-based decisions (Ploeg & Veugelers, 2008). Pakistan is an exception where government agencies provide funds for research and development side-by-side few NGOs like JICA and TUBITAK etc. Worldwide, the total R&D expenditure is majorly contributed by the leading industrialized nations of the world. (Huang & Huang, 2018) found that particular field of nanotechnology is mainly funded by four main funding agencies of the leading industrialized countries including National Science Foundation (NSF), USA, the National Natural Science Foundation, China (NSFC), Ministry of Education, Culture, Sports, Science & Technology (MEXT), Japan and the German Research Foundation (DFG). The different fields of studies analysed at different stages and durations and tried to find out that which funding agency funded which field of scientific discipline and upto what percentage. (ABT, 1984) examined funding in astronomy, (Zhao, 2010) analyzed library and information sciences, (Wang & Shapira, 2011) analyzed nanotechnology. Such studies do not determine the pattern of overall research profile of researchers which eventually leads their inclination towards certain scientific fields. Thus, the systematic analysis lacks across different scientific disciplines and thus information is very limited to guage research funding variation in different scientific fields of research (Huang & Huang, 2018).

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This gap is being filled under this study to measure the researchers' tendencies to carry out R&D in scientific fields of research. The measure of this tendency in Pakistan is critical in the context that Pakistan's R&D spending is out of any comparison which is around 0.005% to that of US (Congressional Service, 2021) and 0.007% to that of China (Atkinson, 2019). Pakistan needs more focus on where to spend efficiently and effectively citing its abysmal comparison and having no significant increase in federal R&D spending at a time when nations are growing exponentially. For instance, China has grown its R&D budget up to 330 percent from $23 billion-to-$98 billion (Atkinson, 2019).

The research tendency leads many researchers towards failure in availing the grants. The researchers feel that their high profile like prominent publications and patents will make them potential candidate to seek funds from the funding agencies but the selection procedure depends upon research need, quality and the expected return (Grimpe, 2012). Similarly, In Pakistan funding agencies focus on Import substitution, Export Orientation and Indigenous need of the state to finance grants to researchers for indigenous R&D (Foundation, 2021). In such scenario, any viable project can be rejected by the Technical Committees citing non-utilization of research at indigenous level.

The women factor is less participating in scientific research. In eight comparisons out of 26 countries, mainly from EU along with NSF and NIH of USA, wherein women were found to have equal or higher rates of success (Cruz-Castro et al., 2023). Women contribution is found least despite being in high rank collaborations, and get less funding even if they get similar level of networkings like men (Bellotti et al., 2022). However, research funding chances increase by 13.8% through collaboration(Davies et al., 2022). Although getting funding is not necessarily means productivity as research studies showed negative correlation at different levels (Lawson et al., 2021) but the question of giving equal opportunity to gender can lead to less discrimination towards other factors like geographical locations, races and even religion.

Further, only public sector agencies are funding research. Private sector contribution is negligible. Globally, academia share in global research is less than 50%, however it is true that public sector funds have major share (Zhang et al., 2020) except few exceptions of big giants like Tesla invests heavily in R&D to encourage open-source patenting and partnership for inclusive growth of technology (Wang et al., 2022).

The concentration of financial resources by funding agencies towards certain giants is already under question. There is a constant or declining relationship between research performance and the grant magnitude (Aagaard et al., 2020). This does not mean than funding should be discontinued. In fact, its judicious spread increases its productivity and the impact reflects beyond the quantity(Heyard & Hottenrott, 2021). It is a truth that funded research is more cited than unfunded research and matthew effect is also greater for funded articles (Roshani et al., 2021). So, effective distribution of funded research should be very much thoughtful to gain maximum opportunity cost.

Objectives

The objective of this study is to determine the fields of research our scientists are keen to explore or the inclination of researchers in natural sciences to seek funding. Second, it will explore the tendency of the Universities and R&D organizations in Pakistan trying to get funding. Third is to determine the demographic profile of active researchers. Here, the ones who submit research proposal are active researchers. The gender disparity in scientific fields is also calculated.

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Finally, the tests of the peer review reports are also performed to gauge their dependence over different fields of study and between themselves.

Scope of the Study

The study is conducted for Pakistani researchers and thus contains the profile of Pakistani researchers' portfolios, their affiliations with research institutes, gender disparity and demographics. This study further determines our direction in the fields and thus gaps are identified to have more focus by policy makers. The funding agencies can now initiate specific calls in certain areas where research is needed.

The study is descriptive in nature and specific to the context of Pakistan. The study is supported through analyzing the data of research projects submitted by the scientists to funding agencies in order to seek grants in two different calls for proposals launched in different years without any limitation on any field.

Hypothesis

Hypotheses will address our research questions like gender parity, provincial participation, fields of research, extent of scientific endeavors in terms of research applications submitted from different institutes with their respective cities and the analysis of single blinded peer review within their scoring vis-à-vis field of studies:

H1: The ratio of female participation is different across provinces

H2: The female participation across different fields of scientific study is at par with overall average female participation

H3: Provinces are not participating in research activities as per their share

H4: The active scientific community is not evenly distributed across the different scientific fields of research

H5: The probability of success of research projects is limited to few institutes or few institutes take lead in harnessing funds from local funding agencies

H6: Most of the Cities are not active in scientific research

H7: Peer Review/Grading of a project by two Subject Experts has significant association

H8: Peer Review Grading of a project has significant association with the field of study

3. Methodology

Data

The data was gathered in 2019 and then in 2020 under two different calls for proposals (CFP). A total of 1787 research projects received, 1030 in 2019-20 while 757 in another call for proposals in 2020-21.

First call for proposal was launched in national dailies in July, 2019. The main theme of CFP was to seek research proposals to carry out indigenous research with main focus on import substitution, export enhancement and to fulfill indigenous requirements. The total cost of one research project was limited to Rs. 20.0 Million. Any scientist could submit one project either in the category of Triple Helix Model (Industry-Academia Linkage) and Consortium (scientists from multiple organizations). All public and private sector organizations were allowed to submit project proposals. A total of 1130 research projects were received, 219 in Triple Helix and 911 under consortium research grants. The scientists were given 75 days to submit their research projects.

The second call was launched in 2020 where only triple helix was allowed as it was more inclined towards the three parameters of import substitutions, export enhancement and serving

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indigenous needs. The scientists were given 60 days to submit research projects. A total of 757 projects received under this call.

There were 13 categories in which research projects were categorized like “Agriculture & Food Security”, “Information Communication Technology”, “Earth, Environment & Climate Change”, “Biotechnology, Biochemistry & Molecular Biology”, “Water & Soil”, “Energy”, “Engineering & Manufacturing”, “Health Sciences”, “Livestock”, “Chemistry & Physics”, “Other Emerging Areas”, “Science Technology Education Mathematics (STEM)” and “Space Sciences”.

The total research projects submitted in two different calls for proposals were 1787 from 163 Universities and R&D Organizations. The data is quite sufficient to analyse the scientific trend of a scientific community.

Variables

The variables of interest in the data of research proposals were the ‘fields of study’, ‘associated institutes’, ‘demographic background’, ‘gender’ and more importantly ‘evaluation rating’ awarded by the subject experts after Peer Review. Each project was Peer Reviewed by two subject experts. The inter-dependence of the evaluations of the peer review grading by subject experts was also considered. Along-side, peer review grading was also analyzed for any expected association with the field of study that particular research proposal belongs to.

Inclusion Criteria

All the project proposals submitted under the two calls were reviewed by the Screening Committee consisting of eminent scientists of the relevant fields. The projects having suitable criteria and strength in its scientific objectives were selected for peer review by the subject experts. Two subject experts evaluated each project proposal. An amount of Rs. 10,000 was paid to every subject expert as an appraisal fee.

Sample & Sampling Technique

All the submitted research projects were our sample to determine the organisations’ inclination towards certain fields. Their geographical distribution was understood. Gender distribution was also calculated. However, the sample of research projects evaluated by the subject experts, wherein each project was evaluated by two subject experts, were the only projects recommended by the screening committee for Peer Review. So, a total of 622 research projects were evaluated by 1244 subject experts and each expert rated a project into A, B and C categories, A being highest priority for funding and C being the least. A subject expert was supposed to evaluate each research project through a questionnaire carrying 15 questions in total.

Statistical Model

Being descriptive in nature, simple statistical methods of frequencies, and inter-connected models like spatial distribution, province, city, gender, obtained grades by the subject experts in relation to their respective organisations were used. The result ultimately determined that which university has what success rate in front of Screening Committee which reflects the apparent quality of research projects and then what percentage of projects were awarded A, B and C grades. ‘A’ for highest priority for funding while ‘C’ being the least.

The Chi-Square test was used to compare peer review evaluation by subject experts I & II and to that of the field of study of the research proposals.

4. Results and Analysis

Gender Analysis:

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Gender

	Frequency	Percent	Valid Percent	Cumulative Percent
Female	338	18.9	18.9	18.9
Male	1449	81.1	81.1	100.0
Total	**1787**	**100.0**	**100.0**	

The analysis of gender contribution explains that 18.9% women were interested to carry out research activities in Pakistan as compared to 81.1% men. The overall literacy ratio in girls is 57% while that of Boys is 73% (Report, 2020) but these results reflect that scientific contribution is mainly from boys. This ratio seems quite optimal as Finland is also reported to have only 20.45% females participation is S&T in 2020 (Chan & Torgler, 2020). The role of women is seen to be familial in the statuses of 'wife' and 'mother' which is strong in developing countries and despite such roles, wherever women is engaged in scientific activities, they perform equally well to that of men (Campion & Shrum, 2004). Maybe, this could be the reason that females are less witnessed in scientific roles. So, at this extent the results in Pakistan are up to the mark and women engaged in scientific activities are seen to be at par with the ratio of the developed nations.

Province-Wise Contribution

	Frequency	Percent	Valid Percent	Cumulative Percent
AJK	16	.9	.9	.9
Baluchistan	25	1.4	1.4	2.3
GB	11	.6	.6	2.9
ICT	272	15.2	15.2	18.1
KPK	225	12.6	12.6	30.7
Punjab	1044	58.4	58.4	89.1
Sindh	194	10.9	10.9	100.0
Total	**1787**	**100.0**	**100.0**	

The provincial percentage of the research projects submission reveals Punjab taking the lead with 58.4% which is understandable being the largest province by population. The surprise comes from Sindh (10.9%) which is less than Federal Capital (15.2%) and even KPK (12.6%). Deprivation of Baluchistan (2.3%) is imminent with 1.4% of total research submission. AJK (0.9%) and GB (0.6%) are the least contributing territories.

Gender Province Crosstabulation

			Province							
			AJK	Balochistan	GB	ICT	KPK	Punjab	Sindh	Total
Gender	Female	Count	0	2	0	45	19	216	56	338
		% within Province	0.0%	8.0%	0.0%	16.5%	8.4%	20.7%	28.9%	18.9%
	Male	Count	16	23	11	227	206	828	138	1449
		% within Province	100.0%	92.0%	100.0%	83.5%	91.6%	79.3%	71.1%	81.1%
	Total	Count	16	25	11	272	225	1044	194	1787

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	% within Province	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Sindh has highest female participation (28.9%) ratio as compared to males (71.1%). Punjab despite being the largest in terms of scientific participation for research and development was at 20.7% in terms of female participation. The Federal Capital has only 16.5% female participation ratio as compared to males. KPK was no surprise being at 8.4% in female participation and Balochistan at 9%. All projects submitted from AJK and GB were from males which is to be considered by policy makers to design policies for gender inclusive participation in these areas.

H1: So, the gender imbalance is evident from the figures that gender ratio in terms of scientific endeavors are strikingly different in different provinces across Pakistan.

Gender vs. Fields of Study

Fields_of_Study * Gender Crosstabulation

		Gender		
		Female	Male	Total
Agr. & Food Sec.	Count	53	160	213
	% within Fields_of_Study	24.9%	75.1%	100.0%
	% within Gender	15.7%	11.0%	11.9%
	% of Total	3.0%	9.0%	11.9%
Biotech., Biochm.	Count	116	331	447
	% within Fields_of_Study	26.0%	74.0%	100.0%
	% within Gender	34.3%	22.8%	25.0%
	% of Total	6.5%	18.5%	25.0%
Chem. & Phy.	Count	46	179	225
	% within Fields_of_Study	20.4%	79.6%	100.0%
	% within Gender	13.6%	12.4%	12.6%
	% of Total	2.6%	10.0%	12.6%
Earth., Env. & Cli	Count	7	62	69
	% within Fields_of_Study	10.1%	89.9%	100.0%
	% within Gender	2.1%	4.3%	3.9%
	% of Total	0.4%	3.5%	3.9%
Energy	Count	13	66	79
	% within Fields_of_Study	16.5%	83.5%	100.0%
	% within Gender	3.8%	4.6%	4.4%
	% of Total	0.7%	3.7%	4.4%
Engg. & Manuf.	Count	13	217	230
	% within Fields_of_Study	5.7%	94.3%	100.0%
	% within Gender	3.8%	15.0%	12.9%
	% of Total	0.7%	12.1%	12.9%
Health Sciences	Count	52	137	189
	% within Fields_of_Study	27.5%	72.5%	100.0%

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	% within Gender	15.4%	9.5%	10.6%
	% of Total	2.9%	7.7%	10.6%
ICT	Count	18	157	175
	% within Fields_of_Study	10.3%	89.7%	100.0%
	% within Gender	5.3%	10.8%	9.8%
	% of Total	1.0%	8.8%	9.8%
Livestock	Count	8	69	77
	% within Fields_of_Study	10.4%	89.6%	100.0%
	% within Gender	2.4%	4.8%	4.3%
	% of Total	0.4%	3.9%	4.3%
Other Emerging Are	Count	1	6	7
	% within Fields_of_Study	14.3%	85.7%	100.0%
	% within Gender	0.3%	0.4%	0.4%
	% of Total	0.1%	0.3%	0.4%
Space Science	Count	0	1	1
	% within Fields_of_Study	0.0%	100.0%	100.0%
	% within Gender	0.0%	0.1%	0.1%
	% of Total	0.0%	0.1%	0.1%
STEM	Count	2	15	17
	% within Fields_of_Study	11.8%	88.2%	100.0%
	% within Gender	0.6%	1.0%	1.0%
	% of Total	0.1%	0.8%	1.0%
Water & Soil	Count	9	49	58
	% within Fields_of_Study	15.5%	84.5%	100.0%
	% within Gender	2.7%	3.4%	3.2%
	% of Total	0.5%	2.7%	3.2%
Total	Count	338	1449	1787
	% within Fields_of_Study	18.9%	81.1%	100.0%
	% within Gender	100.0%	100.0%	100.0%
	% of Total	18.9%	81.1%	100.0%

The female participation across the fields remained close to average except the fields of lesser participation altogether. The only exception was the 'Engineering and Manufacturing' sector which has just 5.7% female participation, almost one fourth of the average women participation in other fields of study.

H2: Female Participation across different fields of study is close to overall average women participation

Fields of Study vs. Provincial Share

Fields_of_Study * Province Crosstabulation

		AJK	Balochistan	GB	ICT	KPK	Punjab	Sindh	Total
Agr. & Food Sec.	Count	0	1	2	16	22	150	22	213
	% within Fields_of_Study	0.0%	0.5%	0.9%	7.5%	10.3%	70.4%	10.3%	100.0%

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Biotech., Biochm. Mol.	Count	4	3	2	42	41	317	38	447
	% within Fields_of_Study	0.9%	0.7%	0.4%	9.4%	9.2%	70.9%	8.5%	100.0%
Chem. & Phy.	Count	4	3	2	34	30	131	21	225
	% within Fields_of_Study	1.8%	1.3%	0.9%	15.1%	13.3%	58.2%	9.3%	100.0%
Earth., Env. & Climate	Count	2	2	2	12	18	25	8	69
	% within Fields_of_Study	2.9%	2.9%	2.9%	17.4%	26.1%	36.2%	11.6%	100.0%
Energy	Count	3	0	1	27	10	31	7	79
	% within Fields_of_Study	3.8%	0.0%	1.3%	34.2%	12.7%	39.2%	8.9%	100.0%
Engg. & Manuf.	Count	1	7	0	59	35	103	25	230
	% within Fields_of_Study	0.4%	3.0%	0.0%	25.7%	15.2%	44.8%	10.9%	100.0%
Health Sciences	Count	0	2	0	26	23	115	23	189
	% within Fields_of_Study	0.0%	1.1%	0.0%	13.8%	12.2%	60.8%	12.2%	100.0%
ICT	Count	2	4	1	40	29	70	29	175
	% within Fields_of_Study	1.1%	2.3%	0.6%	22.9%	16.6%	40.0%	16.6%	100.0%
Livestock	Count	0	0	0	2	7	61	7	77
	% within Fields_of_Study	0.0%	0.0%	0.0%	2.6%	9.1%	79.2%	9.1%	100.0%
Other Emerging Are	Count	0	1	0	0	2	2	2	7
	% within Fields_of_Study	0.0%	14.3%	0.0%	0.0%	28.6%	28.6%	28.6%	100.0%
Space Science	Count	0	0	0	1	0	0	0	1
	% within Fields_of_Study	0.0%	0.0%	0.0%	100.0 %	0.0%	0.0%	0.0%	100.0%
STEM	Count	0	0	1	6	2	7	1	17
	% within Fields_of_Study	0.0%	0.0%	5.9%	35.3%	11.8%	41.2%	5.9%	100.0%
Water & Soil	Count	0	2	0	7	6	32	11	58
	% within Fields_of_Study	0.0%	3.4%	0.0%	12.1%	10.3%	55.2%	19.0%	100.0%
Total	Count	16	25	11	272	225	1044	194	1787
	% within Fields_of_Study	0.9%	1.4%	0.6%	15.2%	12.6%	58.4%	10.9%	100.0%

An overall look into the data reveals that Punjab is taking the lead overall and has its presence in almost every field of study. Islamabad Capital Territory is more focused towards Energy, Engineering and Manufacturing, and Information Communication Technologies and that a big portion (35.3%) of projects in STEM came from the capital and then 41.2% from Punjab. KPK is doing good in exploring Other Emerging Areas which is at 28.6% equal to that of Punjab and Sindh.

Balochistan despite being reported rich in mineral resources is just at 2.9% in terms of project generation in this area. Scientific community of Balochistan is not interested to carry out research in minerals and its land resources. It means that there is no focus on research in Balochistan even in an area where this province should take the lead. KPK has developed its potential to generate projects in earth sciences which is 26.1% of the total projects generated in Earth Sciences.

Sindh is at 12.2% in the health sector which is quite low and neither justified in-terms of population nor the territorial fraction.

H3: Provinces are not participating across different research fields as per their share.

Fields of Study Ratio

Fields_of_Study

	Frequency	Percent	Valid Percent	Cumulative Percent
Biotech., Biochm.	447	25.0	25.0	25.0
Engg. & Manuf.	230	12.9	12.9	37.9

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Chem. & Phy.	225	12.6	12.6	50.5
Agr. & Food Sec.	213	11.9	11.9	62.4
Health Sciences	189	10.6	10.6	73.0
ICT	175	9.8	9.8	82.8
Energy	79	4.4	4.4	87.2
Livestock	77	4.3	4.3	91.5
Earth., Env. & Climate	69	3.9	3.9	95.4
Water & Soil	58	3.2	3.2	98.6
STEM	17	1.0	1.0	99.6
Other Emerging Are	7	.4	.4	99.9
Space Science	1	.1	.1	100.0
Total	**1787**	**100.0**	**100.0**	

The data of scientific fields by participation reflected Biotechnology, Biochemistry and Molecular Biology being at the top with 25% of the total research projects submissions. Engineering and Manufacturing at 12.9%, Chemistry and Physics at 12.6%, Agriculture & Food Sciences is the focus of 11.9% scientists, Health Sciences at 10.6%, Information & Communication Technologies received 9.8% attention, Energy related projects were around 4.4%, Livestock at 4.3%, Earth Sciences just at 3.9%, Water & Soil at 3.2%, Science Technology Education Mathematics received only 1%, Other Emerging Areas 0.4% and Space Sciences is least focused area with 0.1%.

A closure look reveals a comfortable picture for our indigenous food requirements but the focus on Industrial side is ignored. The field of Engineering and Manufacturing needs more focus to have its direct impact on economy. More focus of scientists is towards Biotechnology, Biochemistry and Molecular Biology related disciplines, medium towards Engineering, Physics, Chemistry & IT and least towards Energy, Livestock, earth sciences, climate change & Water and Soil; and almost none towards the fields of STEM, Emerging Areas and Space Sciences was found.

H4: This gives strength to our hypothesis that stark differences in the research intention of scientists are found across the different fields. Hence our hypothesis stands true that the scientific community's inclination is not evenly distributed in the fields of scientific research.

Ratio of Participation of Universities/Organizations:

Sr	Universities/Organizations	Frequency	Percent	Valid Percent	Cumulative Percent
1	National University of Science & Technology Islamabad	111	6.2	6.2	6.2
2	Khawaja Farid University of Engineering and IT, R.Y.Khan	85	4.8	4.8	11.0
3	University of Agriculture, Faisalabad	79	4.4	4.4	15.4
4	GC University Faisalabad	73	4.1	4.1	19.5
5	University of Veterinary and Animal Sciences Lahore	73	4.1	4.1	23.6
6	University of the Punjab Lahore	64	3.6	3.6	27.1
7	COMSATS University Islamabad	62	3.5	3.5	30.6
8	Cholistan University of Veterinary and Animal Sciences Bahawalpur	54	3.0	3.0	33.6

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9	University of Karachi	44	2.5	2.5	36.1
10	PMAS-Arid Agriculture University Rawalpindi	43	2.4	2.4	38.5
11	Islamia University Bahawalpur	39	2.2	2.2	40.7
12	Nuclear Institute of Biotechnology and Genetic Engineering Faisalabad	39	2.2	2.2	42.9
13	Baha-ud-Din Zakariya University Multan	38	2.1	2.1	45.0
14	MNS University of Agriculture Multan	36	2.0	2.0	47.0
15	University of Management & Technology	35	2.0	2.0	49.0
16	NED University of Engineering & Technology Karachi	34	1.9	1.9	50.9
17	University of Engineering and Technology Lahore	32	1.8	1.8	52.7
18	Quaid-i-Azam University, Islamabad.	28	1.6	1.6	54.2
19	University of Education	27	1.5	1.5	55.7
20	University of Gujrat	27	1.5	1.5	57.2
21	International Islamic University Islamabad	23	1.3	1.3	58.5
22	Pakistan Council for Scientific and Industrial Research	23	1.3	1.3	59.8
23	University of Engineering & Technology Peshawar	23	1.3	1.3	61.1
24	University of Health Sciences Lahore	23	1.3	1.3	62.4
25	Air University Islamabad	22	1.2	1.2	63.6
26	Bahria University	21	1.2	1.2	64.8
27	Gomal University D.I.Khan	20	1.1	1.1	65.9
28	Abdul Wali Khan University Mardan	17	1.0	1.0	66.9
29	University of Lahore	17	1.0	1.0	67.8
30	Balochistan University of IT Engg. and Mgt. Sciences Quetta	16	.9	.9	68.7
31	Mehran Unviersity of Engineering and Technology Jamshoro	16	.9	.9	69.6
32	Lahore University of Management Sciences	15	.8	.8	70.5
33	Bacha Khan University Charsadda	14	.8	.8	71.2
34	GC Women University Faislabad	14	.8	.8	72.0
35	GC University Lahore	13	.7	.7	72.7
36	GIK Insititute of Technology Swabi	13	.7	.7	73.5
37	Hazar University Mansehra	13	.7	.7	74.2
38	National Textile University Faisalabad	13	.7	.7	74.9
39	National University of Medical Sciences Rawalpindi	13	.7	.7	75.7
40	National University of Technology Islamabad	13	.7	.7	76.4

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41	Mirpur University of Science & Technology AJK	12	.7	.7	77.1
42	University of Peshawar	12	.7	.7	77.7
43	Jinnah University for Women Karachi	11	.6	.6	78.3
44	AKHUWAT Institute of Science & Technology Faisalabad	10	.6	.6	78.9
45	Minhaj University Lahore	10	.6	.6	79.5
46	Pak-Austria Fachhochschule Institute of Applied Sciences & Technology Haripur	10	.6	.6	80.0
47	University of Haripur	10	.6	.6	80.6
48	Institute of Space Technology Islamabad	9	.5	.5	81.1
49	Lahore Garrison University	9	.5	.5	81.6
50	National Agriculture Research Center	9	.5	.5	82.1
51	Sindh Agriculture University Tandojam	9	.5	.5	82.6
52	University of Swabi	9	.5	.5	83.1
53	University of Balochistan Quetta	9	.5	.5	83.6
54	FC College University Lahore	8	.4	.4	84.1
55	University of Lakki Marwat	8	.4	.4	84.5
56	University of Science & Technology Bannu	8	.4	.4	84.9
57	Dow University of Health Sciences Karachi	7	.4	.4	85.3
58	Islamia College University Peshawar	7	.4	.4	85.7
59	IT University Lahore	7	.4	.4	86.1
60	Karakoram International University GB	7	.4	.4	86.5
61	Pakistan Atomic Energy Commission	7	.4	.4	86.9
62	Pakistan Council for Research in Water Resources	7	.4	.4	87.3
63	Private Sector	7	.4	.4	87.7
64	University of Agriculture Peshawar	7	.4	.4	88.1
65	University of Sargodha	7	.4	.4	88.5
66	University of Sialkot	7	.4	.4	88.9
67	Women University Multan	7	.4	.4	89.3
68	Kohat University of Science & Technology KPK	6	.3	.3	89.6
69	Riphah International University	6	.3	.3	89.9
70	University of Sindh Jamshoro	6	.3	.3	90.3
71	Sir Syed CASE University of Technology Islamabad	5	.3	.3	90.5
72	Lahore College for Women University	5	.3	.3	90.8
73	Pakistan Insititute of Engineering and Applied Sciences Islamabad	5	.3	.3	91.1

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74	University of Engineering & Technology Taxila	5	.3	.3	91.4
75	FAST University	4	.2	.2	91.6
76	Ghazi University D.G.Khan	4	.2	.2	91.8
77	Khyber Medical University Peshawar	4	.2	.2	92.1
78	MNS Unviersity of Engineering & Technology Multan	4	.2	.2	92.3
79	Pakistan Institute of Nuclear Science & Technology	4	.2	.2	92.5
80	Pvt	4	.2	.2	92.7
81	Sindh Madrassatul Islam University Karachi	4	.2	.2	92.9
82	University of Swat	4	.2	.2	93.2
83	University of AJK	4	.2	.2	93.4
84	Virtual University of Pakistan	4	.2	.2	93.6
85	Aga Khan University Karachi	3	.2	.2	93.8
86	Abbottabad University of Science & Technology	3	.2	.2	94.0
87	Shaheed Benazir Bhutto University of Vet. & Animal Sc. Sakrand	3	.2	.2	94.1
88	Institute of Business Administration Sukkur	3	.2	.2	94.3
89	Karachi Institute of Economics and Technology	3	.2	.2	94.5
90	National Skills University Islamabad	3	.2	.2	94.6
91	Pakistan Council for Renewable Energy Technologies	3	.2	.2	94.8
92	Shaheed BB Women University Peshawar	3	.2	.2	95.0
93	SZABIST Karachi	3	.2	.2	95.1
94	Ayub Agriculture Research Council Faisalabad	2	.1	.1	95.2
95	Allama Iqbal Open University Faisalabad	2	.1	.1	95.4
96	Balochistan University of Engineering & Technology Khuzdar	2	.1	.1	95.5
97	CABI Institute Rawalpindi	2	.1	.1	95.6
98	CECOS University of IT and Emerging Sciences Peshawar	2	.1	.1	95.7
99	College of Veterinary and Animal Sciences Jhang	2	.1	.1	95.8
100	Fatima Jinnah Women University Rawalpindi	2	.1	.1	95.9
101	Govt. College Women Unviersity Sialkot	2	.1	.1	96.0
102	NFC Institute of Engineering & Technology Multan	2	.1	.1	96.1

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103	Nuclear Institute for Agriculture and Biology Faisalabad	2	.1	.1	96.3
104	Nuclear Institute of Food and Agriculture Peshawar	2	.1	.1	96.4
105	National University of Modern Languages Islamabad	2	.1	.1	96.5
106	Rehman Medical Insitute Peshawar	2	.1	.1	96.6
107	University of Baltistan Skardu	2	.1	.1	96.7
108	University of Malakand	2	.1	.1	96.8
109	University of Poonch AJK	2	.1	.1	96.9
110	University of Veterinary and Animal Sciences Bahawalpur	2	.1	.1	97.0
111		1	.1	.1	97.1
112	ABASYN University Islamabad	1	.1	.1	97.1
113	Cotton Research Institute Multan	1	.1	.1	97.2
114	Capital University of Science & Technology Islamabad	1	.1	.1	97.3
115	Dairy Dev. Veterinary Research & Disease Investigation Abbottabad	1	.1	.1	97.3
116	DESTO Islamabad	1	.1	.1	97.4
117	Directorate of Outreach Agriculture KPK	1	.1	.1	97.4
118	Dawood University of Engineering & Technology Karachi	1	.1	.1	97.5
119	Govt. Post Graduate College Bannu	1	.1	.1	97.5
120	Hydrocarbon Development Institute Islamabad	1	.1	.1	97.6
121	Horticultural Research Institute Islamabad	1	.1	.1	97.6
122	Institute of Management Sciences Peshawar	1	.1	.1	97.7
123	INMOL Cancer Hospital Lahore	1	.1	.1	97.8
124	Iqra National University Peshawar	1	.1	.1	97.8
125	Institute of Radiotherapy and Nuclear Medicine Peshawar	1	.1	.1	97.9
126	King Edward Medical University Lahore	1	.1	.1	97.9
127	Kohsar University Murree	1	.1	.1	98.0
128	Lasbela University of Agriculture, Water and Marine Sciences Uthal Balochistan	1	.1	.1	98.0
129	NFC Institute of Engineering & Fertilizer Research Faisalabad	1	.1	.1	98.1
130	Nazeer Hussain University Karachi	1	.1	.1	98.2
131	Oil and Gas Development Company	1	.1	.1	98.2
132	Okara University	1	.1	.1	98.3

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133	Pakistan Agriculture Research Council Islamabad	1	.1	.1	98.3
134	Pakistan Institute of Medical Sciences	1	.1	.1	98.4
135	Pakistan Museum of Natural History	1	.1	.1	98.4
136	Pakistan Nuclear Regulatory Authority	1	.1	.1	98.5
137	Poultry Research Institute	1	.1	.1	98.5
138	University of Poonch Rawalakot	1	.1	.1	98.6
139	Qamar College of Veterinary & Animal Sciences Jhang	1	.1	.1	98.7
140	Shah Abdul Latif University Khairpur	1	.1	.1	98.7
141	Shaheed BB University Sheringal	1	.1	.1	98.8
142	Shaheed BB University of Veterinary and Animal Sciences Sakrand	1	.1	.1	98.8
143	Safe Blood Transfusion Programme	1	.1	.1	98.9
144	Science Foundation University	1	.1	.1	98.9
145	Superior Group of Colleges	1	.1	.1	99.0
146	Sarhad University of Science & Information Technology Peshawar	1	.1	.1	99.0
147	Shaikh Zaid Hospital	1	.1	.1	99.1
148	Textile Institute of Pakistan Karachi	1	.1	.1	99.2
149	University of Central Punjab Lahore	1	.1	.1	99.2
150	University of Engineering & Technology Faisalabad	1	.1	.1	99.3
151	University of Engineering & Technology R.Y.Khan	1	.1	.1	99.3
152	University of Engineering & Technology Swat	1	.1	.1	99.4
153	University of Health Sciences Karachi	1	.1	.1	99.4
154	University Institute of Information Technology	1	.1	.1	99.5
155	University of Chitral	1	.1	.1	99.6
156	University of Wah	1	.1	.1	99.6
157	US Pak. Center for Advanced Studies in Water Jamshoro	1	.1	.1	99.7
158	University of Swabi	1	.1	.1	99.7
159	Veterinary Research Institute Lahore	1	.1	.1	99.8
160	Veterinary Research Institute Peshawar	1	.1	.1	99.8
161	Veterinary Research Institute Swat	1	.1	.1	99.9
162	Women University AJK	1	.1	.1	99.9
163	Women University Bahawalpur	1	.1	.1	100.0
	Total	**1787**	**100.0**	**100.0**	

Out of total 1787 research projects submitted from 163 research organizations in two different calls for proposals, 28.8% (47/163) research inclined organizations contributed 80% of Research

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& Development projects to carry out indigenous research in Pakistan and the rest 71.2% organizations have that remaining 20% share. NUST is on top with 111 (6.2%) research projects submitted, followed by Khawaja Farid University of Engineering and IT of Rahim Yar Khan with 85 projects (4.8%) and then comes University of Agriculture, Faisalabad with 79 projects (4.4%). It is pertinent to mention here that the top positions are occupied by some new universities rising on the horizon of research. This reflects that the inclination of research is more in the new organizations than the old ones.

H5: This supports our hypothesis that few institutes take lead in harnessing funds from local funding agencies citing their high participation through research proposals which raises their probability of success.

Ratio of City-Wise Participation

City-Wise Research Tendency

		Frequency	Percent	Valid Percent	Cumulative Percent
1	Lahore	371	20.8	20.8	20.8
2	Islamabad	290	16.2	16.2	37
3	Faisalabad	237	13.3	13.3	50.3
4	Karachi	143	8	8	58.3
5	Bahawalpur	99	5.5	5.5	63.8
6	Multan	87	4.9	4.9	68.7
7	Rahim Yar Khan	85	4.8	4.8	73.4
8	Peshawar	72	4	4	77.4
9	Rawalpindi	66	3.7	3.7	81.1
10	Gujrat	27	1.5	1.5	82.7
11	Jamshoro	26	1.5	1.5	84.1
12	Quetta	23	1.3	1.3	85.4
13	D.I.Khan	21	1.2	1.2	86.6
14	Haripur	20	1.1	1.1	87.7
15	Swabi	19	1.1	1.1	88.8
16	Mardan	17	1	1	89.7
17	Charsadda	13	0.7	0.7	90.4
18	Abbottabad	11	0.6	0.6	91
19	Bannu	10	0.6	0.6	91.6
20	Sahiwal	10	0.6	0.6	92.2
21	Mansehra	9	0.5	0.5	92.7
22	Risalpur	9	0.5	0.5	93.2
23	Sialkot	9	0.5	0.5	93.7
24	Tandojam	9	0.5	0.5	94.2
25	Lakki Marwat	8	0.4	0.4	94.6
26	Mirpur	7	0.4	0.4	95
27	Sargodha	7	0.4	0.4	95.4

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28	DGK	6	0.3	0.3	95.7
29	Gilgit	6	0.3	0.3	96.1
30	Vehari	6	0.3	0.3	96.4
31	Kohat	5	0.3	0.3	96.7
32	Skardu	5	0.3	0.3	97
33	Swat	5	0.3	0.3	97.3
34	Taxila	5	0.3	0.3	97.5
35	Jhang	4	0.2	0.2	97.8
36	Sakrand	4	0.2	0.2	98
37	Wah Cantt	4	0.2	0.2	98.2
38	Khairpur	3	0.2	0.2	98.4
39	Muzaffarabad	3	0.2	0.2	98.5
40	Sukkur	3	0.2	0.2	98.7
41	AJK	2	0.1	0.1	98.8
42	Khuzdar	2	0.1	0.1	98.9
43	Rawalakot	2	0.1	0.1	99
44	Missing	1	0.1	0.1	99.1
45	Bagh	1	0.1	0.1	99.2
46	Battagaram	1	0.1	0.1	99.2
47	Bhimber	1	0.1	0.1	99.3
48	Chilas	1	0.1	0.1	99.3
49	Chitral	1	0.1	0.1	99.4
50	Kamra	1	0.1	0.1	99.4
51	Lower Dir	1	0.1	0.1	99.5
52	Malakand	1	0.1	0.1	99.6
53	Masehra	1	0.1	0.1	99.6
54	Murree	1	0.1	0.1	99.7
55	Okara	1	0.1	0.1	99.7
56	Pattoki	1	0.1	0.1	99.8
57	Thatta	1	0.1	0.1	99.8
58	Upper Dir	1	0.1	0.1	99.9
59	Uthal	1	0.1	0.1	99.9
60	Wah	1	0.1	0.1	100
	Total	**1787**	**100**	**100**	

Research & Development in the largest city of Karachi (8%) is less than Lahore (20.8%), Islamabad (16.2%) and even Faisalabad (13.3%). In a country of 160 districts (Pakistan Census 2017, n.d.), each consists of multiple cities, only sixty cities submitted a research project for funding and the top ten percent contribute 82.7% of the total research contribution.

The students, if admitted in any institute except these ten cities, reduce their chances by one fifth to opt scientific research as their profession. Thus increasing urbanization. The policy makers

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should think of research organizations at remote areas to facilitate those students who cannot maneuver in big cosmopolitan cities. Only 10 cities contribute 82.7% of the research share in terms of their attempt to seek scientific research proposals.

H6: Our hypothesis holds true that most of the cities in Pakistan are not active in scientific research.

Ratio of Fields of Study

	Fields_of_Study	Total Research Projects	Recommended by Scrutiny Committee	Success Percentage
1	Biotech., Biochm.	447	158	35.3
2	Engg. & Manuf.	230	88	38.3
3	Chemistry & Physics	225	77	34.2
4	Agr. & Food Sec.	213	65	30.5
5	Health Sciences	189	73	38.6
6	Info. & Comm. Tech.	175	58	33.1
7	Energy	79	28	35.4
8	Livestock	77	28	36.4
9	Earth., Env. & Climate	69	24	34.8
10	Water & Soil	58	14	24.1
11	STEM	17	5	29.4
12	Other Emerging Areas	7	3	42.9
13	Space Science	1	1	100.0
	Total	**1787**	**622**	**34.8%**

The Scrutiny Committee comprising over relevant subject experts had more than 15 meetings, each comprising over relevant subject experts. These committees selected 622 research proposals out of 1787 for Peer Review by subject experts. An overall criterion was the quality of the project in terms of national development of Pakistan. The average range in terms of percentage of success across the fields of study did not have any significant variation. These projects were Peer Reviewed by the experts. Each project was sent to two experts for peer review who submitted their responses in terms of A (Highest Priority for Funding), B (Medium Priority for Funding) & C (Least Priority for Funding). Each expert was given two weeks time for Peer Review on a Performa carrying 15 questions. These three categories helped the funding agency to take final decision through the Technical Committees. After months of exercise, all responses were obtained through extensive follow-up. In few cases where responses were extra ordinarily delayed, the experts were changed but very few in number. Following is the detailed data:

Variation in Grading of Experts-I and Experts-II:

Summary of the grading by Expert-I and Expert-II

Expert-I Grading	Frequency	Percent	Valid Percent	Cumulative Percent	Expert-II Grading	Frequency	Percent	Valid Percent	Cumulative Percent
A	174	28.0	28.0	28.0	A	189	30.4	30.4	30.4
B	194	31.2	31.2	59.2	B	213	34.2	34.2	64.6
C	254	40.8	40.8	100.0	C	220	35.4	35.4	100.0
Total	622	100.0	100.0		Total	622	100.0	100.0	

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Expert_I * Expert_II Crosstabulation

			Expert_II			
			A	B	C	Total
Expert_I	A	Count	68	57	49	174
		Expected Count	52.9	59.6	61.5	174.0
	B	Count	44	78	72	194
		Expected Count	58.9	66.4	68.6	194.0
	C	Count	77	78	99	254
		Expected Count	77.2	87.0	89.8	254.0
Total		Count	189	213	220	622
		Expected Count	189.0	213.0	220.0	622.0

As the expected count is reported less than the actual count at four points and at five points expected count is higher than actual. So, we run Chi-Square test to determine whether if those observed counts are different enough for the test to be significant or for the association to be significant.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14.830[a]	4	.005
Likelihood Ratio	14.925	4	.005
N of Valid Cases	622		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 52.87.

Chi-Square statistic is 14.830 and P-value is 0.005 which is less than α value and the result is significant. The assumption of Chi-Square test reveals that assumption is not violated because zero cells have expected count less than 5 and the minimum is actually 52.87.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.154	.005
	Cramer's V	.109	.005
N of Valid Cases		622	

Phi-0.154 as correlation co-efficient means that the relationship of Peer Review by Expert-I and Expert-II on each other is from ‘small to moderate’ and is significant.

H7: So, we will accept our hypothesis that there is significant association between the grading of Expert-I and Expert-II.

Fields of Study vs. Peer Review Grading (Expert-I & Expert-II):

Chi-Square Tests
(Field of Study vs Expert-I Peer Review Grading)

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	27.609[a]	24	.277
Likelihood Ratio	28.565	24	.237
N of Valid Cases	622		

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a. 11 cells (28.2%) have expected count less than 5. The minimum expected count is .28.

Chi-Square Tests
(Field of Study vs Expert-II Peer Review Grading)

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	35.098[a]	24	.067
Likelihood Ratio	37.461	24	.039
N of Valid Cases	622		

a. 12 cells (30.8%) have expected count less than 5. The minimum expected count is .30.

Similarly, the Chi-Square test in Crosstabs in SPSS with the field of study versus expert-I and Expert-II grading revealed us that the expected count is more than 20% which violates the assumption. As the likelihood ratio is also 28.565 for Expert-I and 37.461 for Expert-II and the P-value is also not significant which is 0.237 for Expert-I and 0.39 for Expert-II

H8: Hence we need to accept the null hypothesis that there is no association between Peer Review Grading and the field of study of the research proposal.

This reflects that the parameter of Peer Review evaluation is totally based on the factors other than the particular scientific field, the research proposal belongs to.

Discussion

Provinces are not focusing on the scientific research as per their share which means the resources are wasted in provinces. Further, the scientific community is ignoring important fields like Engineering & Manufacturing as these fields make a country export-oriented, fulfilling indigenous needs and import substitution Most of the cities are not active in research in Pakistan as only 10 cities contribute more than 82% research contribution. This reflects that the probability of someone to become a scientist lies only in 10 cities. This is the reason that these few institutes have monopolized the scientific research in Pakistan as only 47 institutes constitute 80% research share and the rest of hundreds of institutes have least probability to harness research funding. The gender disparity is also strikingly different in different provinces. The Peer Review grading of the projects has significant association to the peer review of same project by the second expert. Also, there is no significant association of peer review grading with the field of study which is a clear indication that the Peer Review has no biasness. As determined in literature review, the judicious allocation of resources for research funding across the board is not possible for a funding agency unless equal participation is ensured by Universities' heads.

6. Conclusion, Limitation & Recommendations

Conclusion

Pakistan is highly focused on Biotechnology and its allied fields, least bothered in the research of new fields like Energy, Other Emerging Areas and Space Sciences. Even IT is given a moderate attention. Few scientific fields are altogether neglected for R&D which an atomic country like Pakistan cannot afford to ignore like Space Sciences, Emerging Areas and STEM. The least interest in R&D in the disciplines like Energy, Livestock, Climate Change and Earth Sciences is also a nightmare citing adverse energy crisis (Tahir Masood & Shah, 2012) and the worst flood hit areas due to climate change.

There is association found between the Peer Review of subject experts. That when two subject experts evaluate same project proposals, there is moderate association that the grading would be

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somewhat similar. Moreover, the association between the 'field of study/scientific discipline' is not associated with Peer Review grading which reflects that whatever is the scientific field, the peer review is independent in its grading. The analysis of review grading reflects that the peer review has no biasness and the standard is maintained by the funding agencies and the subject experts.

More than 80% research portfolio is hunted by only ten cities in Pakistan and thus if you want to be a scientist, you need to be in these ten cities or else your chance to become a scientist will reduce by one fifth. Though every city cannot be research centric but for a big country like Pakistan, 5th largest by population, these ten cities can not suffice R&D requirements of the whole country.

Provinces' share is also extremely uneven. The share of Sindh in generating scientific research projects is 30% which is less than that of Islamabad and even KPK. Surprisingly, whole KPK province is less than Federal Capital in generating research projects.

Women participation in 'Engineering and Manufacturing sectors' was just 5.7% which is one fourth of the average ratio of female participation in other fields of study. No female participated from AJK and Gilgit Baltistan. The female participation in Punjab was less than expected and it was critically low in KPK and Balochistan. Balochistan is rich in natural resources (Survey, 2018) and it needs special focus to create research projects in the fields of earth sciences, as research revealed this province is least bothered to explore its minerals and other natural resources.

Limitations

The criterion of screening committee is subjective in nature. All the projects were qualitatively analyzed by the subject experts of relevant field. The study was not controlled at any stage and thus a variation is expected in controlled study. The submission of research proposal to a funding agency reflects the intention of scientists to carry out research in specific fields but the actual funding may differ field-wise as to what fields are funded and which fields are not given priority by the review experts. The scientists and the institutes were not approached to submit projects; instead the call for proposals was launched in the national dailies. The categories of research projects may be more in numbers which could have given more clarity.

Recommendations

The purpose of this research is to have inclusive contribution and to generate policy level guidelines to improve indigenous research & development profile of Pakistan; be it in terms of gender, provincial or city wise contribution, University-wise contribution in research and Peer Review Evaluation. Pakistani researchers need to align themselves with national priorities. The sectors like Engineering and Manufacturing need to be focused for indigenous research & development with high focus on women empowerment in this field. Moreover, the cities with highest available resources should contribute in research as per their capacity which is not the case as resulted in this research. Women contribution needs immediate attention especially in Baluchistan, KPK, AJK and GB.

Future Dimensions:

The opportunity cost should be calculated for women that if they engage in familial roles as compared to be scientists. Success ratio of funding agencies in Pakistan and their comparison to international success rate is also an important area to be explored. Further studies should include the productivity of research projects. This research reveals the scientists' participation in terms of their applications for research grants. The next step is to analyse the productivity in terms of

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grants hunting swhich would reflect the productivity of the research proposals. Few well-known universities and R&D organizations who claim to be top research destinations are not much interested in hunting more research grants. There is a need to carry out the analysis of these institutions to know that whether their research is more productive than the new entrants and to what extent this hypothesis is true. Organizations with new leadership, joined at the time of data collection will enable us to evaluate the scientific leadership of the Rectors/Vice Chancellors. The ratio of public private universities will further reveal about the research differentiation between them.

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