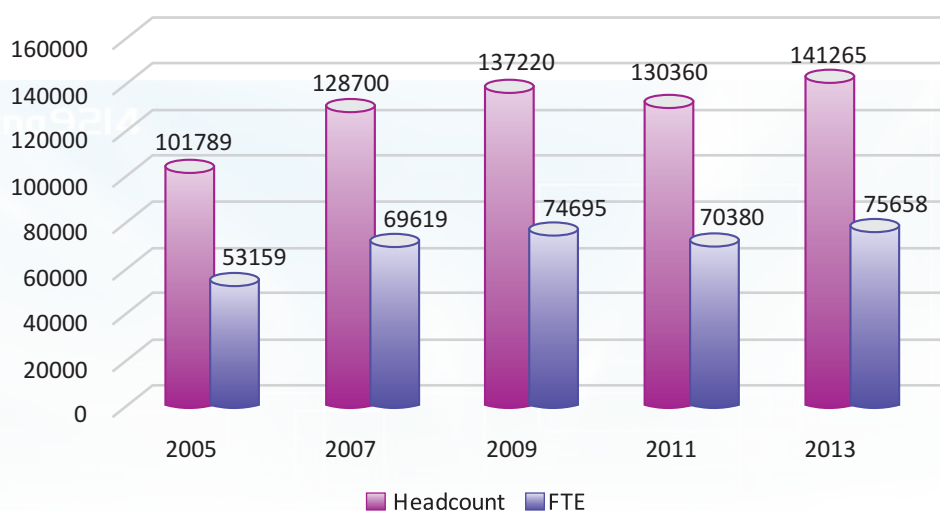


SCIENCE, TECHNOLOGY AND INNOVATION INDICATORS OF PAKISTAN



Pakistan Council for Science and Technology
Ministry of Science and Technology
Islamabad

SCIENCE, TECHNOLOGY AND INNOVATION INDICATORS OF PAKISTAN

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Pakistan Council for Science and Technology
Ministry of Science and Technology
Islamabad
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FOREWORD

Pakistan Council for Science and Technology (PCST) is mandated to advise the Government on science and technology policy issues. Allied to this mandate, one of the important functions of PCST is to facilitate and coordinate the development of policies and strategies for integrating Science, Technology and Innovation (STI) into the national development process in all sectors of economy. Evidence-based policy formulation is the pre-requisite for formulation of realistic policies and plans for national development. Reliable and timely statistics and indicators are essential tools for informed and accurate decision-making. They are needed to measure progress, evaluate impact of on-going programmes, analyze trends, forecast future development needs.

During the past one decade, PCST has been making an effort on regular basis to provide support to policy makers by offering an overview of indicators on science, technology and innovation. Up till now, four editions of key data have been produced since 2005. As a part of this on-going effort, PCST is publishing this report titled "Science, Technology and Innovation Indicators of Pakistan". The main feature of this report is that it is mainly based on the primary data which PCST has collected through its nation-wide 'Research and Development Survey' during 2013-14. To make this report more comprehensive and meaningful, data from secondary national and international sources has also been included.

Females are about one half of the population of Pakistan. It is unthinkable that we can develop and progress without their participation. In the present report, an effort has been made to highlight current state of participation of women in national science, technology and innovation efforts so that appropriate planning can be done to enhance their participation. In order to facilitate readers in viewing the STI performance of Pakistan in entirety, comparisons of Pakistan's data with some selected countries have also been made. It is hoped that information provided in this report will prove useful to all the stakeholders of STI activities ranging from STI policy makers in the government agencies to industrialists in the private sector as we strive to build a national innovation system (NIS) which is vibrant, productive and relative to the economy and society of Pakistan.

At the end, I wish to extend my sincere gratitude to Mr. Muhammad Bashir, Principal Research Officer (Statistics), Dr. Tariq Bashir, Principal Research Officer (Science) and Mr. Imran-ul-Haq, Junior Computer Operator whose dedicated efforts and commitment have contributed towards the successful completion of this report.

Prof. Dr. Mudassir Asrar
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Islamabad

SCIENCE, TECHNOLOGY AND INNOVATION INDICATORS OF PAKISTAN

1. Human Resource in Research and Development

Human resource in research and development is one of the most essential components for innovation and economic growth. R&D and innovation play a vital role in a country's economic development, and outcome of both of these activities directly depends on the number and quality of available human resources. In order to assess progress of present programmes of human resource development and future needs reliable statistics and indicators are required. Equipped with the precise information about human resources available in different fields of science and technology, policy makers and planners are better placed to plan and implement policies as per specific challenges of a country.

Human resource indicators are generally presented in two forms i.e. headcounts and full-time equivalent. '**Headcount**' (**HC**) is the simple counting of the number of people engaged in an activity. While '**full-time equivalent**' (**FTE**) is a method of counting people based on the percentage of time a person devotes to a particular activity. For example, for counting number of researchers in a university, by 'headcount' method, total number of faculty members of the university will be counted. However, for 'full-time equivalent' method, first, it will be determined that how much time a faculty member spends in research. As a rule of thumb, faculty members are assumed to spend 30% of their time in research. Therefore, in FTE method, 100 faculty members will be counted as 30 researchers.

Human resource involved in the R&D activities is called R&D manpower or R&D personnel. R&D personnel are divided into three categories which are as under:

Researchers: *Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned.*

Technicians: *Technicians and equivalent staff are persons whose main tasks require technical knowledge and experience in one or more fields of engineering, physical and life sciences or social sciences and humanities. They participate in R&D by performing scientific and technical tasks involving the application of concepts and operational methods, normally under the supervision of researchers. Equivalent staff performs the corresponding R&D tasks under the supervision of researchers in the social sciences and humanities.*

Other supporting staff: *It includes skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects.*

Total R&D Personnel in Pakistan
 141,265 (HC)
 75,658 (FTE)

The total number of R&D personnel in Pakistan has increased steadily from 2005 to 2013 both as headcount and as full-time equivalent. In 2011, the number of R&D personnel was decreased than the previous year, however, it was increased in the next year (2013).

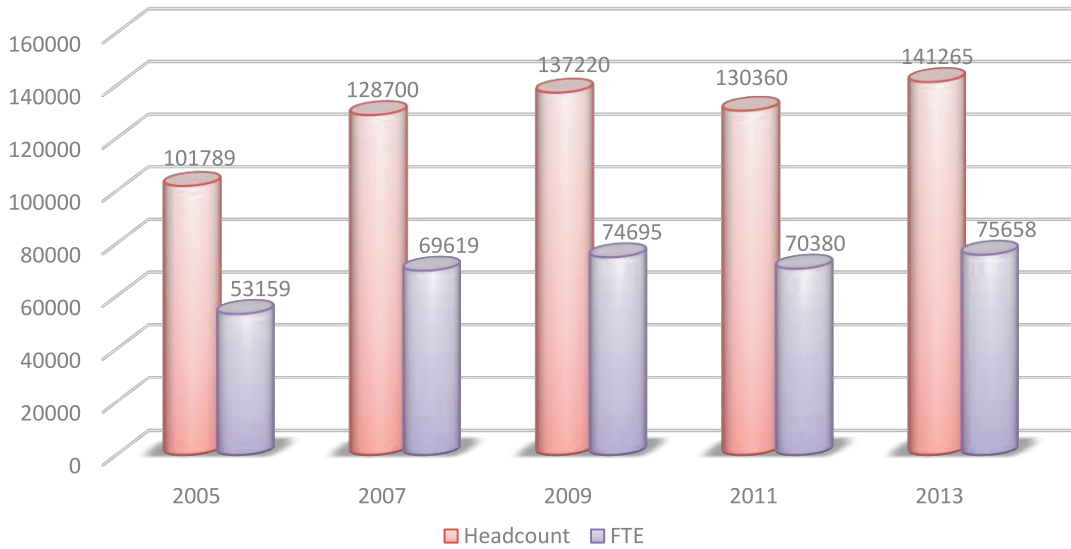


Figure 1.1. Number of R&D personnel (headcount and full-time equivalent) in Pakistan (2005-2013)
 Source: PCST R&D Surveys

Total Researchers in Pakistan
 60,699 (HC)
 30,244 (FTE)

Like the total number of R&D personnel, the number of total researchers in Pakistan has also increased from 2005 to 2013 both as headcount and as full-time equivalent, except in 2011 where a slight decrease was observed.

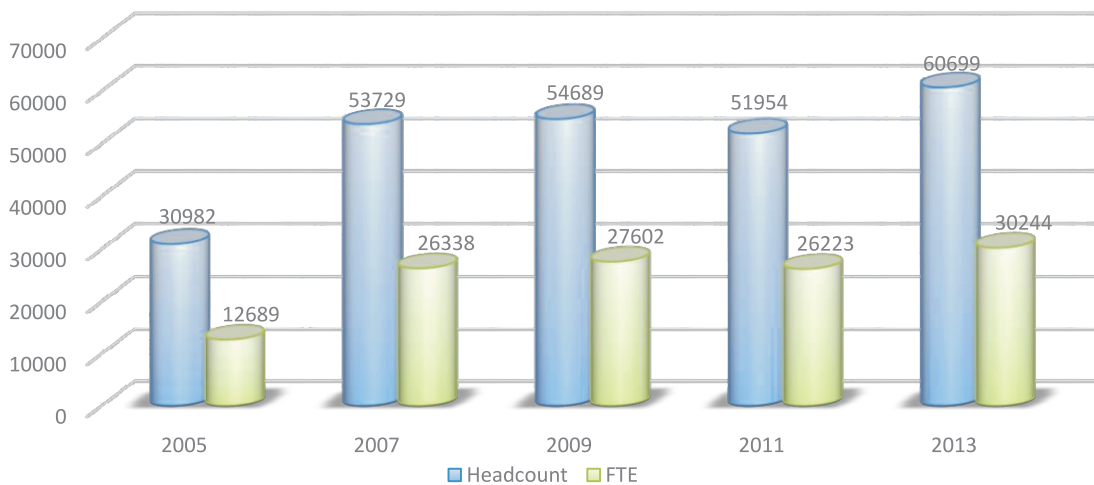


Figure 1.2. Number of researchers (headcount and full-time equivalent) in Pakistan (2005-2013)
 Source: PCST R&D Surveys

Females in R&D Personnel
 17.05% (HC)
 15.86% (FTE)

The percentage of females in the total number of R&D personnel in Pakistan has increased significantly during the period 2005 to 2013.

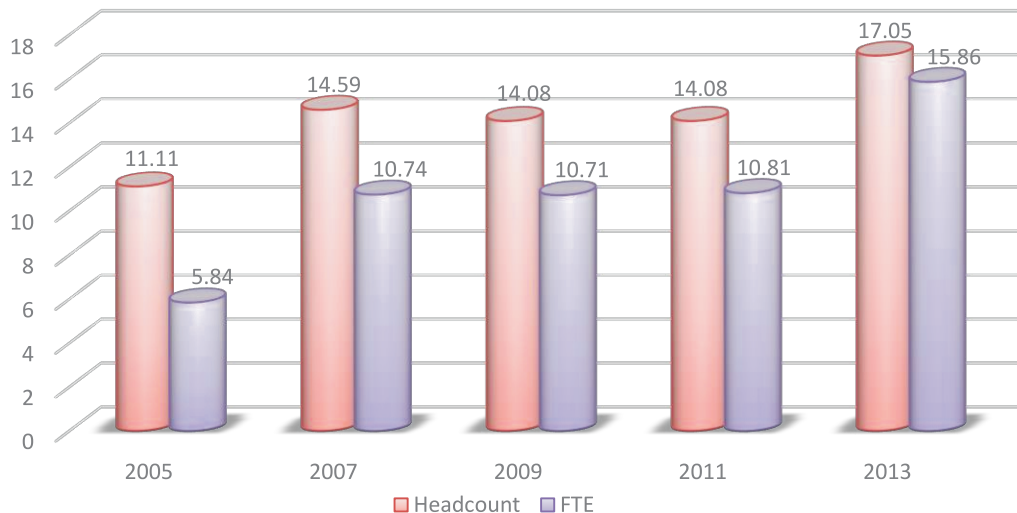


Figure 1.3. Percentage of females (headcount and full-time equivalent) in total number of R&D personnel in Pakistan (2005-2013)
 Source: PCST R&D Surveys

Female Researchers in Pakistan
 29.78% (HC)
 31.27% (FTE)

Over the years, the percentage of female researchers in Pakistan has increased. It has almost doubled in case of full-time equivalent (FTE) researchers from 2005 to 2013.

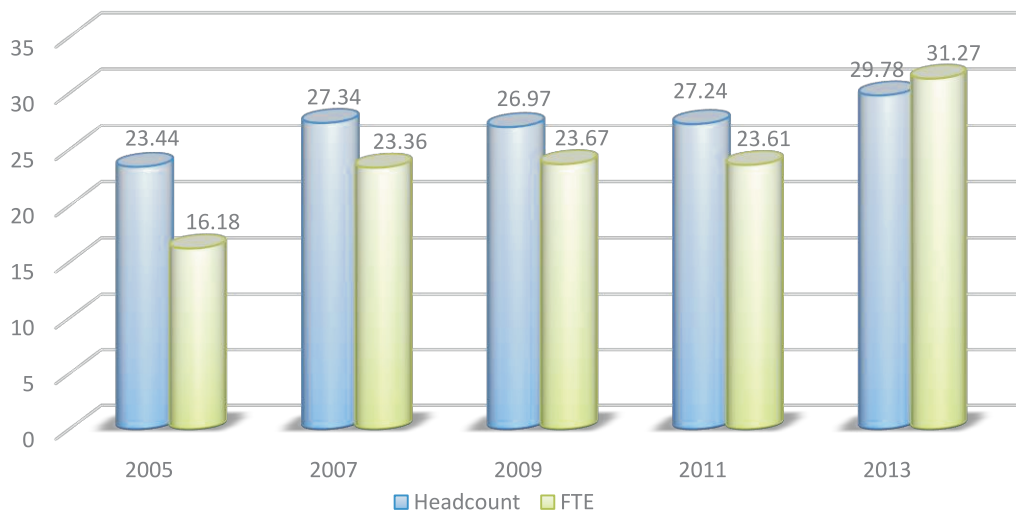


Figure 1.4. Percentage of females (headcount and full-time equivalent) in total number of researchers in Pakistan (2005-2013)
 Source: PCST R&D Surveys

Researchers per million Population
 329 (HC)
 164 (FTE)

The number of researchers per million population, both HC & FTE, in Pakistan has increased compared to the last survey (2011). However, it is almost equal to the number of researchers per million population in 2009 and 2007 surveys.

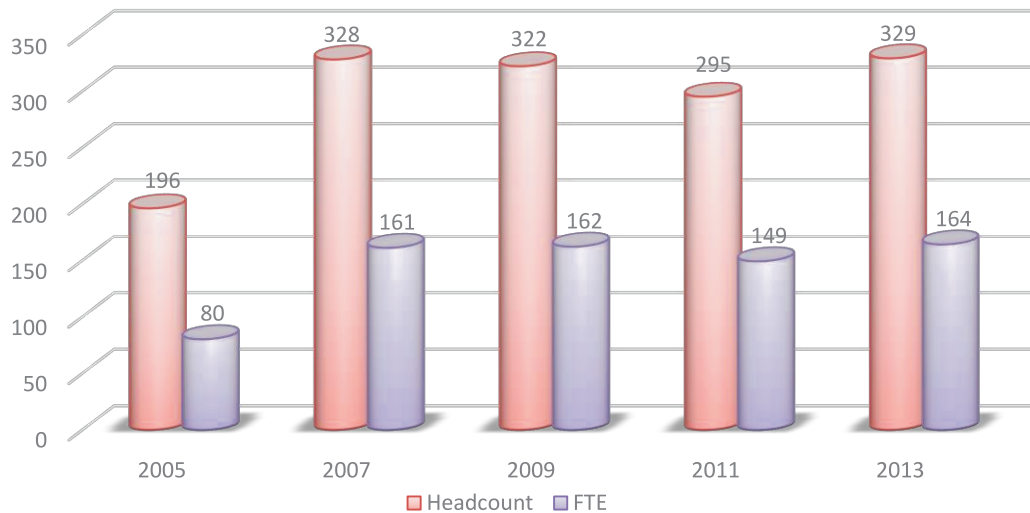


Figure 1.5. Number of researchers (headcount and full-time equivalent) per million population in Pakistan (2005-2013)

Source: PCST R&D Surveys, Pakistan Economic Survey 2012-13

Researchers / thousand LF & E
 1.00 (LF)
 1.07 (E)

The number of researchers per thousand labour force (LF) and per thousand employment (E) has decreased from 2007 to 2011, however, it was increased in 2013.

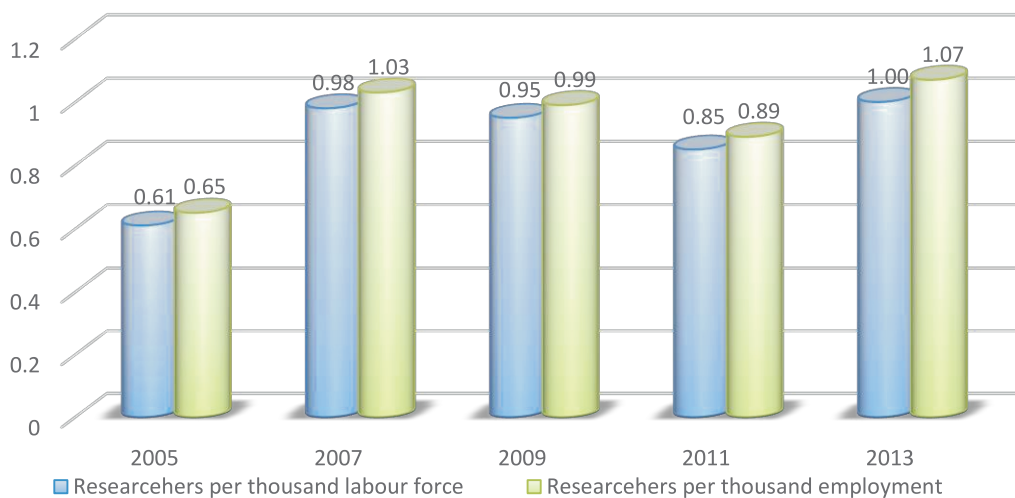


Figure 1.6. Number of researchers (headcount) per thousand labour force and employment in Pakistan (2005-2013)

Source: PCST R&D Surveys, Pakistan Economic Survey 2012-13

Total Technicians in Pakistan
 16,859 (HC)
 13,079 (FTE)

The total number of technicians and equivalent staff in Pakistan has increased, as headcount, over the years. As full-time equivalent, it has decreased from 2007 till 2011. However, it was increased in 2013.

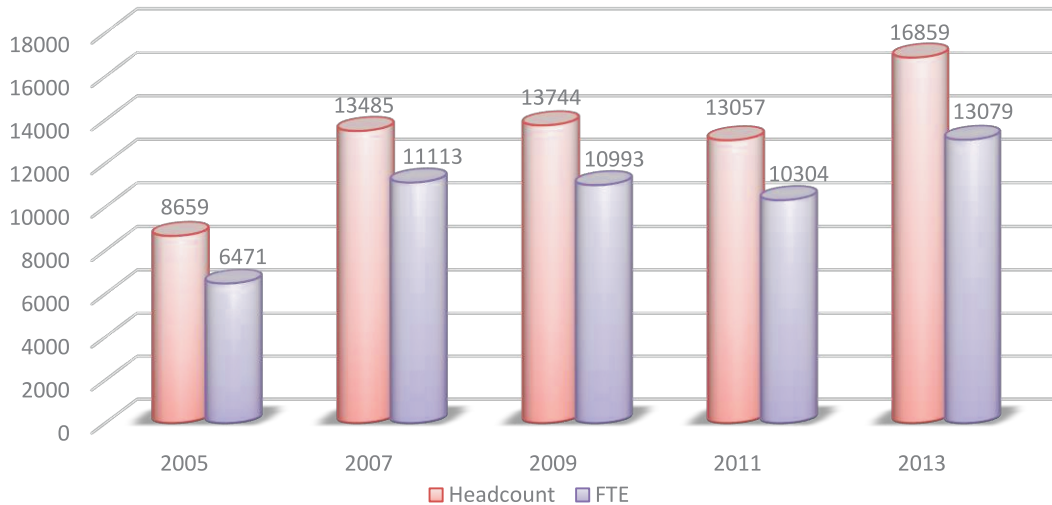


Figure 1.7. Total number of technicians and equivalent staff (headcount and full-time equivalent) in Pakistan (2005-2013)

Source: PCST R&D Surveys

Total Supporting Staff
 63,707 (HC)
 32,335 (FTE)

The supporting staff, both as headcount and full-time equivalent, has not increased too much from 2005 to 2013. Actually its number was the highest in 2009 and it has shown decreasing trend afterwards till 2013.

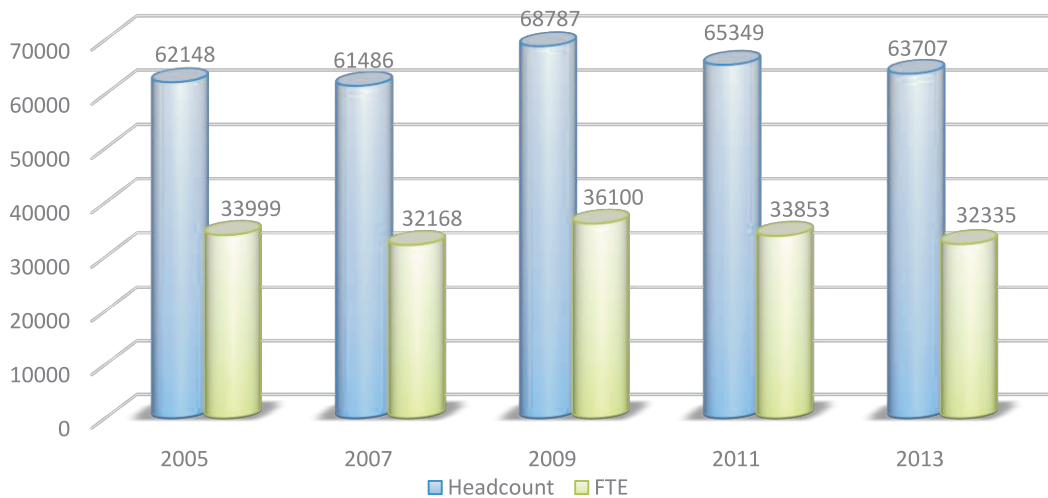


Figure 1.8. Total number of supporting staff (headcount and full-time equivalent) in Pakistan (2005-2013)

Source: PCST R&D Surveys

Researchers in total R&D Manpower
 42.97% (HC)
 39.97% (FTE)

The share of the researchers in the total R&D personnel (manpower) was 42.97% as headcount (HE) which decreased to 39.97% on full-time equivalent (FTE) basis. In case of the technicians, it was opposite as the share of technicians increased when calculated on FTE basis as compared to headcount.

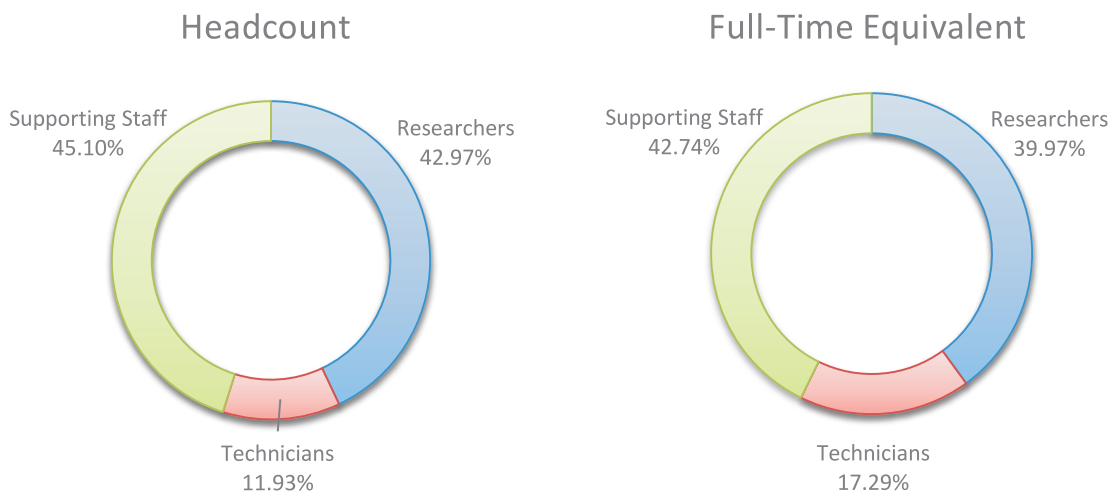


Figure 1.9. Share of researchers, technicians and supporting staff(headcount and full-time equivalent) in total R&D personnel in Pakistan (2013)

Source: PCST R&D Survey 2013-14

Female Technicians
 7.41% (HC)
 7.18% (FTE)

The highest percentage of females is working in the researchers category. The percentage of females working in technicians and supporting staff categories is much lower than that of 'researchers'.

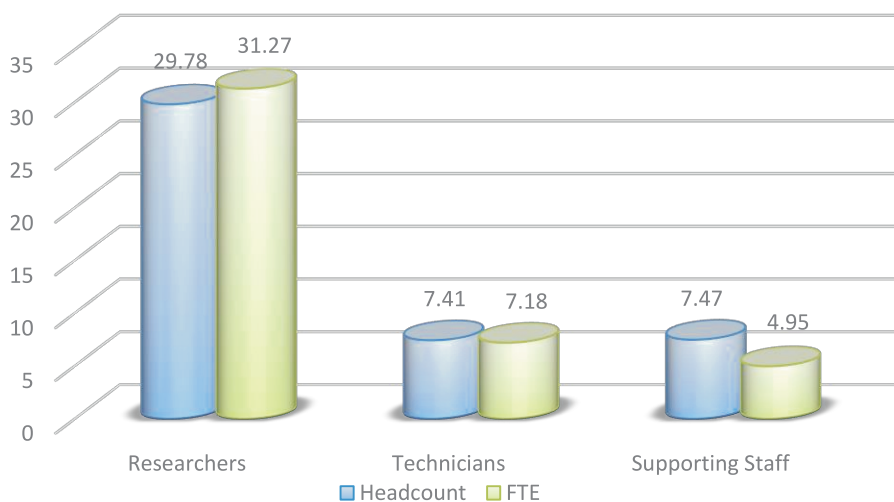


Figure 1.10. Percentage of females in researchers, technicians and supporting staff (headcount and full-time equivalent) categories of total R&D personnel in Pakistan (2013)

Source: PCST R&D Surveys

Researchers (HC) by Employment
 13.48% (Govt)
 86.52% (HEIs)

A large number of researchers work in the higher education institutions (HEIs) as compared to the government R&D organizations (Govt). It must be noted that higher education sector consists of both public and private higher education institutions.

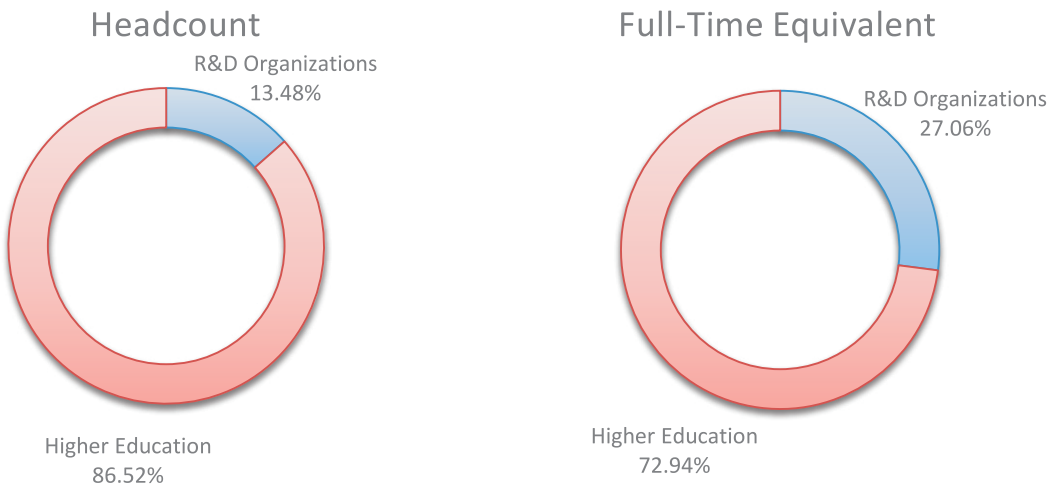


Figure 1.11. Researchers (headcount and full-time equivalent) by sector of employment in Pakistan (2013)

Source: PCST R&D Survey 2013-14

Female Researchers by Employment
 8.99% (Govt)
 39.53% (HEIs)

The percentage of female researchers working in the higher education sector (HEIs) is about four times greater than that of government R&D organizations.

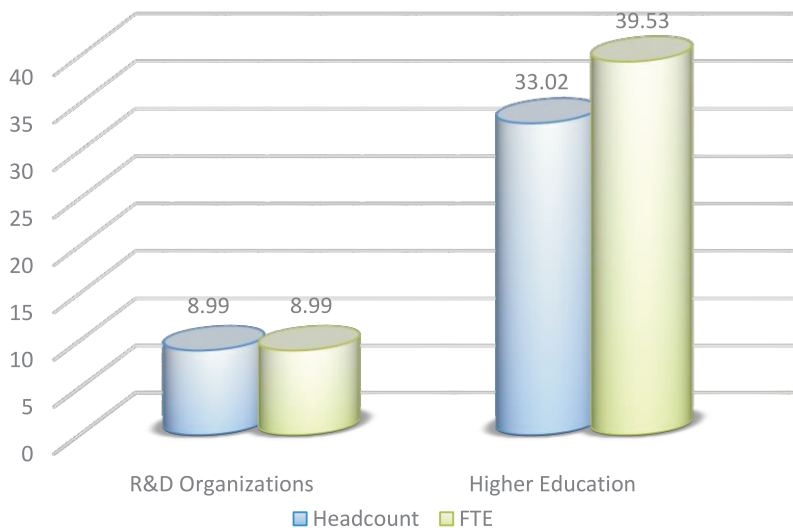


Figure 1.12. Percentage of female researchers(headcount and full-time equivalent) in government R&D organizations and higher education institutions(2013)

Source: PCST R&D Survey 2013-14

Most No. of Researchers in Natural Sciences 14,186

The highest number of researchers works in natural sciences followed by engineering & technology and social sciences. In all the fields, greater number of researchers work in the higher education sector than in the government R&D organizations except in the agricultural sciences where almost equal number of researchers work in both the sectors.

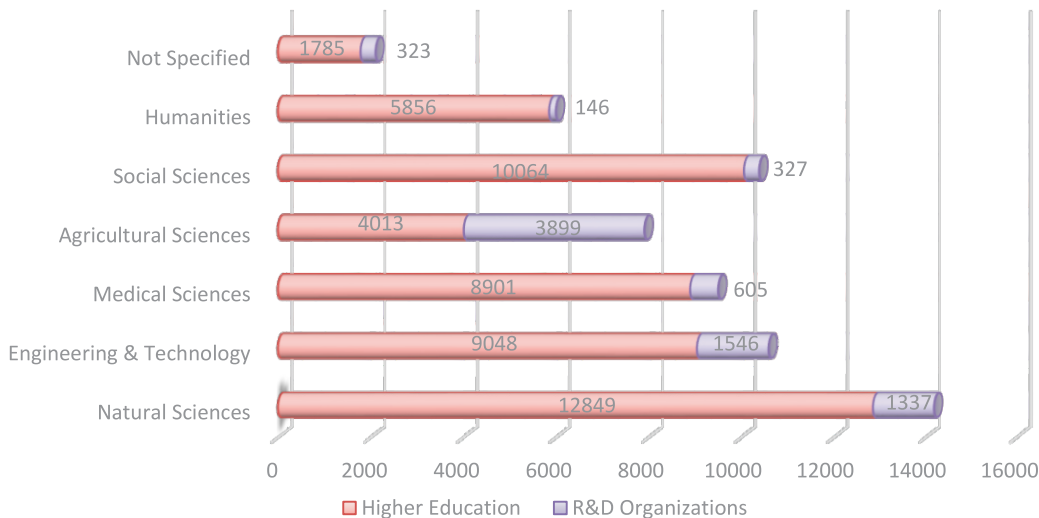


Figure 1.13. Researchers(headcount) by field of science and sector of employment (2013)
Source: PCST R&D Survey 2013-14

23.37% Researchers work in the Natural Sciences

The highest percentage of researchers (23.37%) works in the field of Natural Sciences followed by Engineering & Technology (17.45%) and Social Sciences (17.12%). The lowest percentage of researchers works in the Humanities.

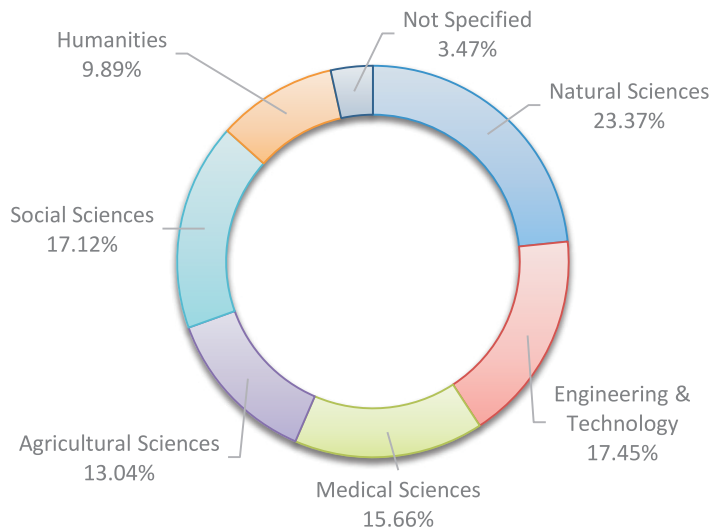


Figure 1.14. Percentage of researchers (headcount) in different fields of science (2013)
Source: PCST R&D Survey 2013-14

Female Researchers in Natural Sciences 4794

The highest percentage of female researchers works in the medical sciences followed by the natural sciences and humanities. The lowest percentage of females works in the agricultural sciences.

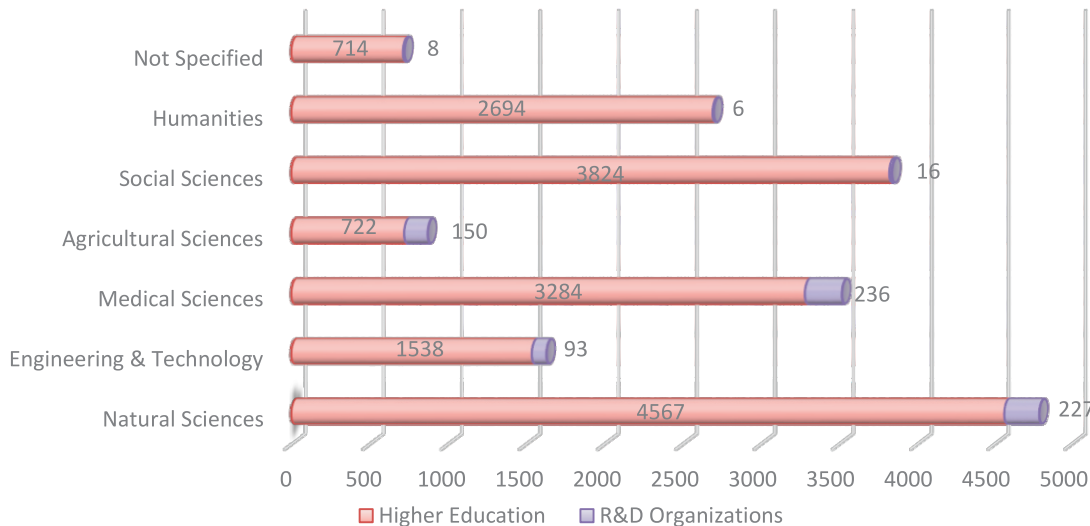


Figure 1.15. Number of female researchers (headcount) by field of science and sector of employment (2013)

Source: PCST R&D Survey 2013-14

26.52% Female Researchers work in Natural Sciences

The highest percentage (26.52%) of females among the female researchers works in Natural Sciences followed by the Social Sciences (21.24%) and Medical Sciences (19.47%).

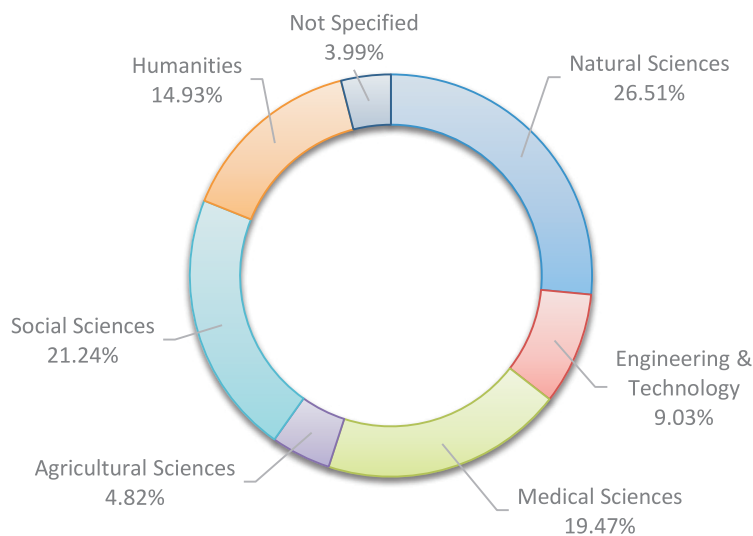


Figure 1.16. Percentage of female researchers (headcount) in different fields of science (2013)

Source: PCST R&D Survey 2013-14

Number of PhDs in Pakistan
 10,670 (HC)
 4,614 (FTE)

A vast majority (71.89%) of researchers (headcount) in Pakistan are educated upto the level of Master's or equivalent. About 17.57 percent of researchers (headcount) hold the degree of PhD while a small number (10.53%) of researchers hold the degree of Bachelor's.

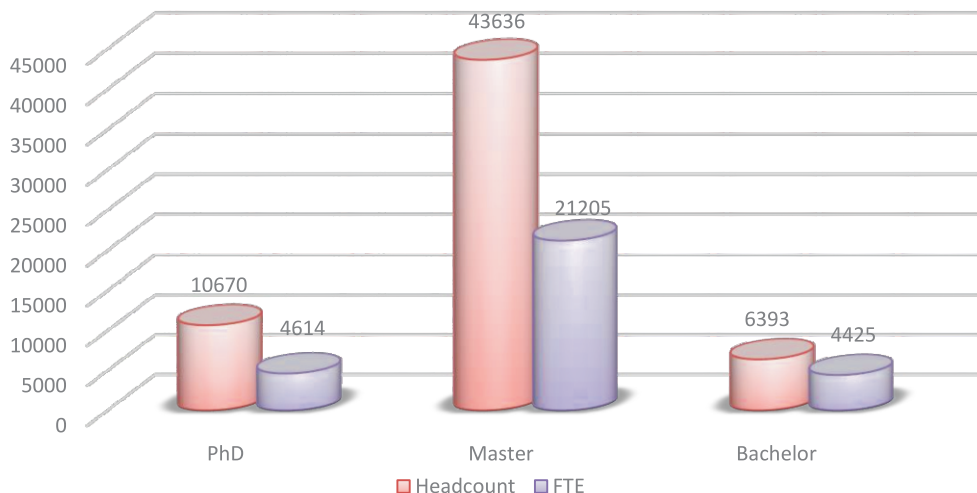


Figure 1.17. Number of researchers (headcount and full-time equivalent) by qualification level (2013)

Source: PCST R&D Survey 2013-14

Percentage of Female PhDs
 19.22 (HC)
 23.45 (FTE)

Among the researchers with PhD degree (headcount), 19.22 percent are females. Female share in researchers with Master's and Bachelor's qualification is even greater (33.40% and 22.74%).

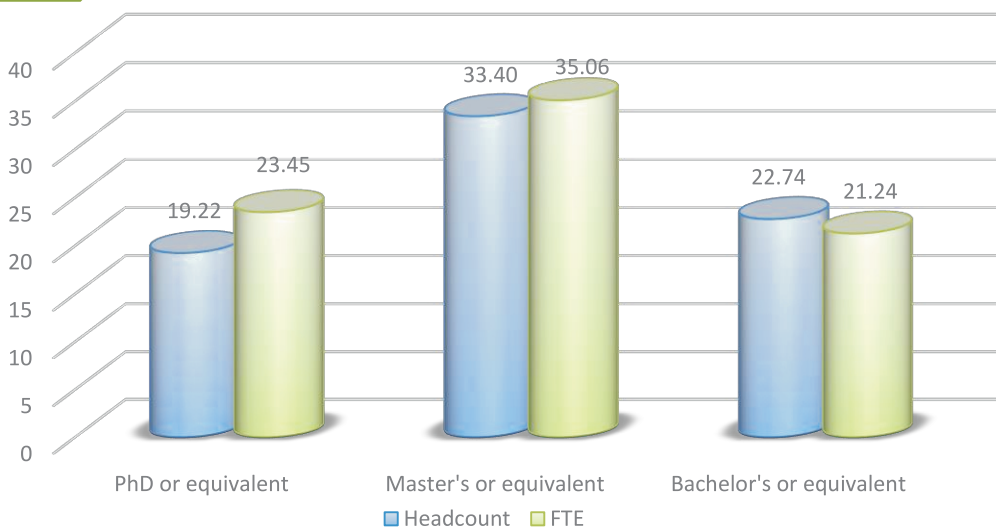


Figure 1.18. Percentage of female researchers (headcount and full-time equivalent) in different qualification levels (2013)

Source: PCST R&D Survey 2013-14

Low Number of Researchers

Pakistan has total 60,699 researchers (headcount) which are much less than many other countries which have much less population than Pakistan.

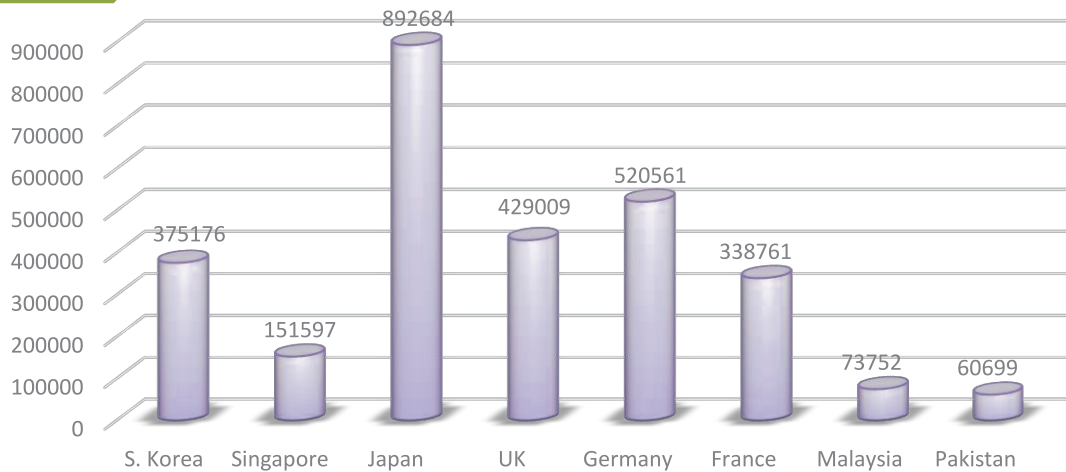


Figure 1.19. Comparison of total number of researchers (headcount) of Pakistan with some other countries (2013)

Source: PCST R&D Survey 2013-14, UIS Online Database

Low Researchers per Million Population

Pakistan has much less number of researchers per million population (329) which was lower than all the other countries included in the comparison. South Korea has about 23 times more researchers than Pakistan.

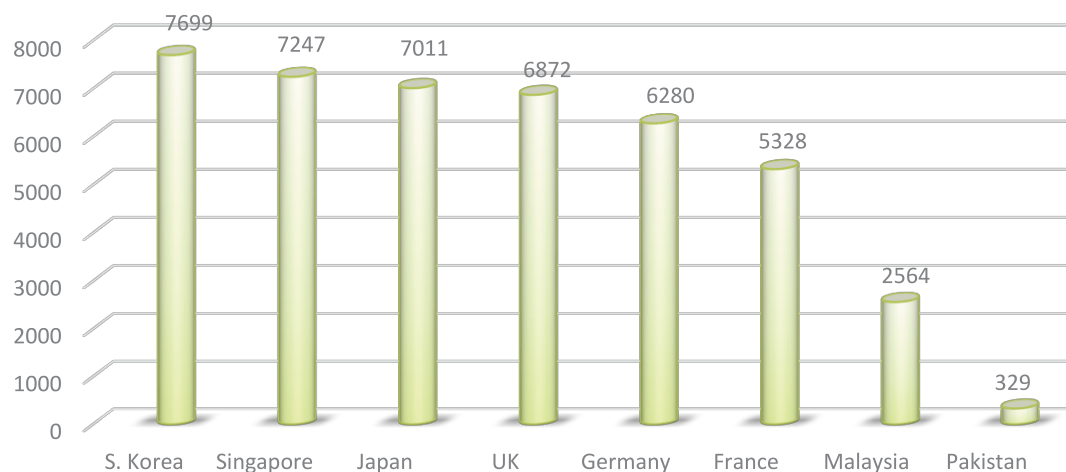


Figure 1.20. Comparison of researchers per million population (headcount) of Pakistan with some other countries (2013)

Source: PCST R&D Survey 2013-14, UIS Online Database

2. Expenditure on Research and Development

Research, development and innovation are regarded as increasingly important for social progress and economic growth of countries. Over time, investments on research and development have increased significantly in many parts of the world. Expenditure on research and development is considered to be one of the leading (input) indicators for benchmarking the R&D performance of countries within an international setting.

The financial resource available for research and development is possibly the second most important factor, after the human resource, for carrying out R&D activities. Therefore, the expenditure on research and development is a widely accepted indicator for evaluating national R&D effort and comparing R&D efforts in different countries and regions. The total financial resources allocated for R&D are very important for any country and affect the volume and quality of its R&D. However, the level / intensity of R&D expenditure measured as a percentage of GDP or per capita is often used to compare R&D effort among different countries. R&D intensity, defined as the share of R&D expenditure in gross domestic product (GDP), is also a major indicator for capturing the knowledge-based economy.

This chapter focuses on the R&D effort of Pakistan in terms of expenditure on research and development. Historical overview of R&D expenditure in Pakistan is given along with detailed analysis of R&D expenditure of Pakistan in 2013. Expenditure, by source of funds, is given to depict which are the main funding sources for R&D in Pakistan. R&D expenditure by sector of performance is also given to show where R&D is being performed in Pakistan. R&D expenditure has been compared with some other countries to present a more holistic picture of the level of R&D expenditure of Pakistan.

Total R&D Expenditure in Pakistan
65,556
 (Rs. Million)

There was a big jump in total R&D expenditure in Pakistan from 2005 to 2007 in terms of actual amount. However, since 2007, total R&D expenditure show slight increase till 2013.

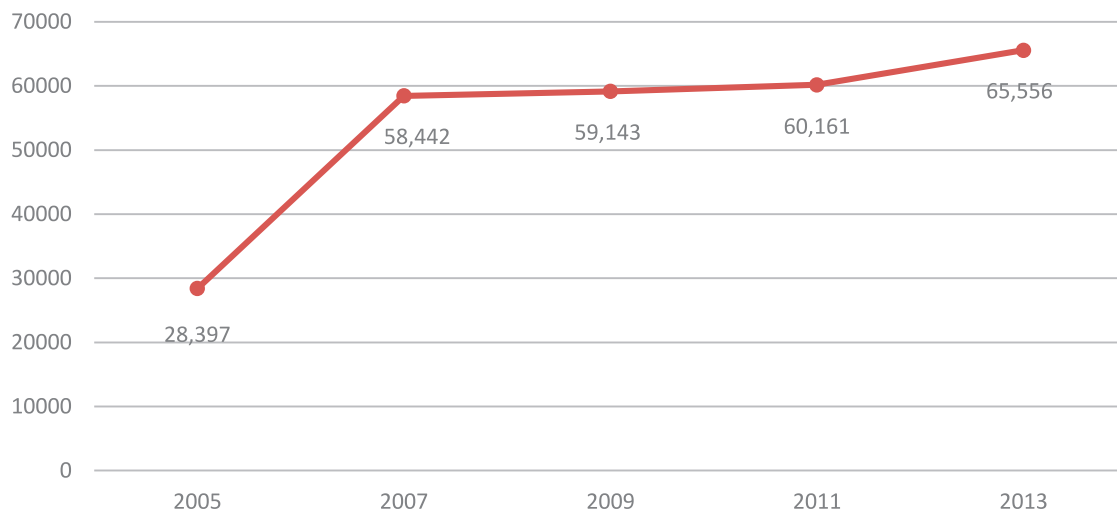


Figure 2.1. Total R&D expenditure (rupees million) in Pakistan (2005-2013)

Source: PCST R&D Surveys

R&D Expenditure (% of GDP) of Pakistan
0.29%

The R&D expenditure as percentage of GDP in Pakistan increased from 2005 to 2007 and showed decrease from 2007 till 2013. However, it is expected to rise in 2014-15.

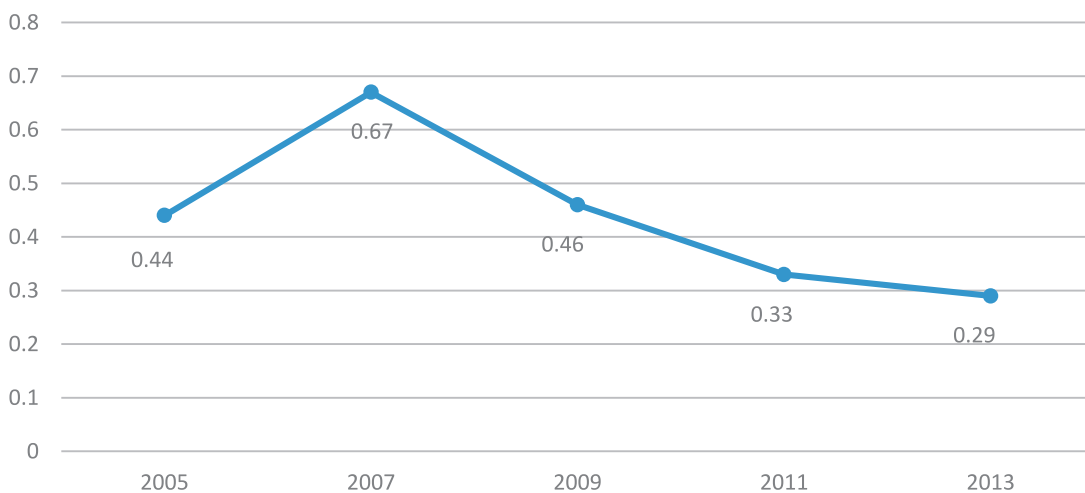


Figure 2.2. R&D expenditure as percent of GDP in Pakistan (2005-2013)

Source: PCST R&D Surveys

R&D Expenditure / Researcher
1.08
 (Rs. Million)

The R&D expenditure per researcher (headcount) per year has been hovering around Rs. 1.1 million from 2007 till 2013.

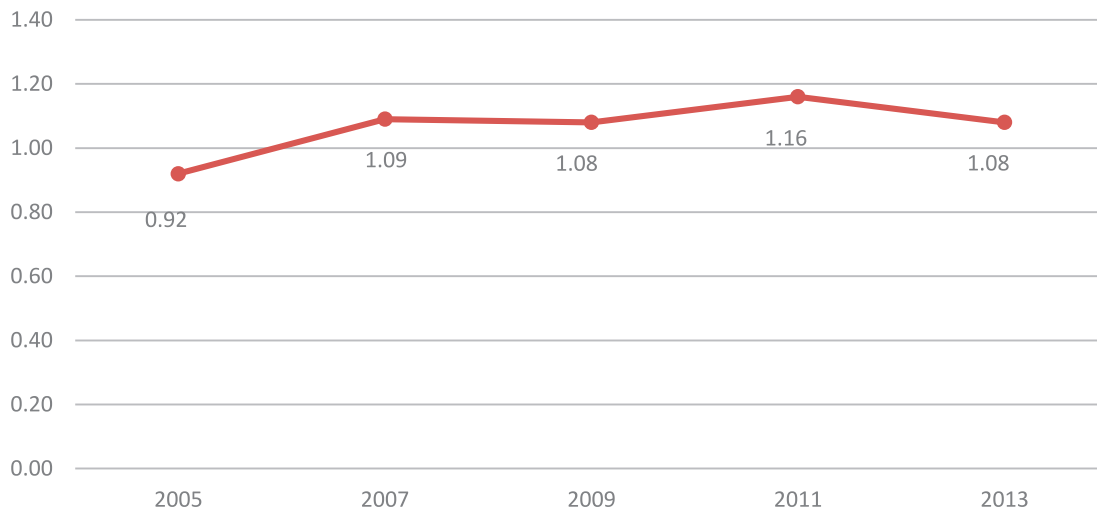


Figure 2.3. R&D expenditure (rupees million) per researcher (headcount) per year (2005-2013)

Source: PCST R&D Surveys

R&D Expenditure per Capita
355.51
 (Rupees)

The R&D expenditure (rupees) per capita in Pakistan has been hovering between Rs. 339 and 369 from 2007 till 2013.

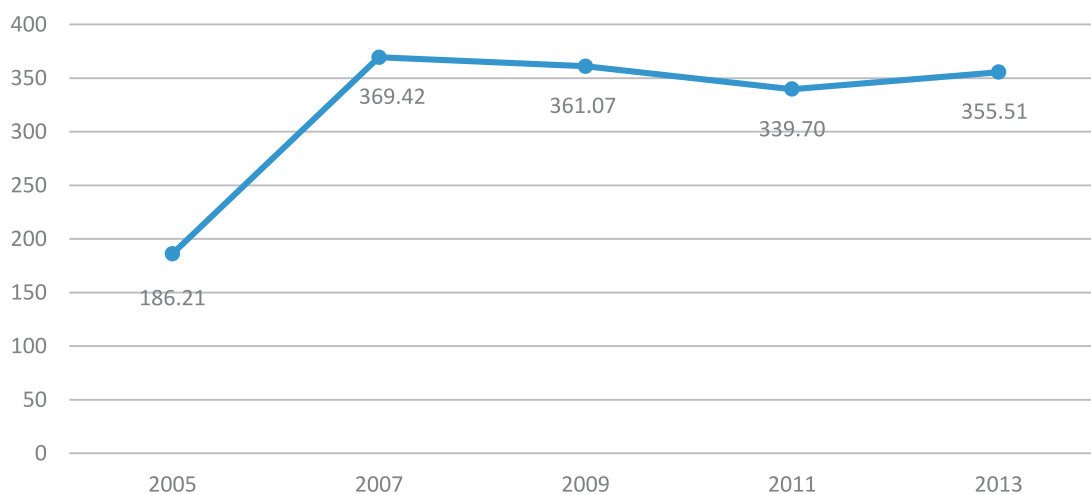


Figure 2.4. R&D expenditure (rupees) per capita in Pakistan (2005-2013)

Source: PCST R&D Surveys

Government Share in R&D Funding 75.26%

Government is the major source of funding of R&D expenditure in Pakistan. Higher education sector is the second highest fund provider for R&D. However, it should be noted that higher education includes both public and private higher educational institutions.

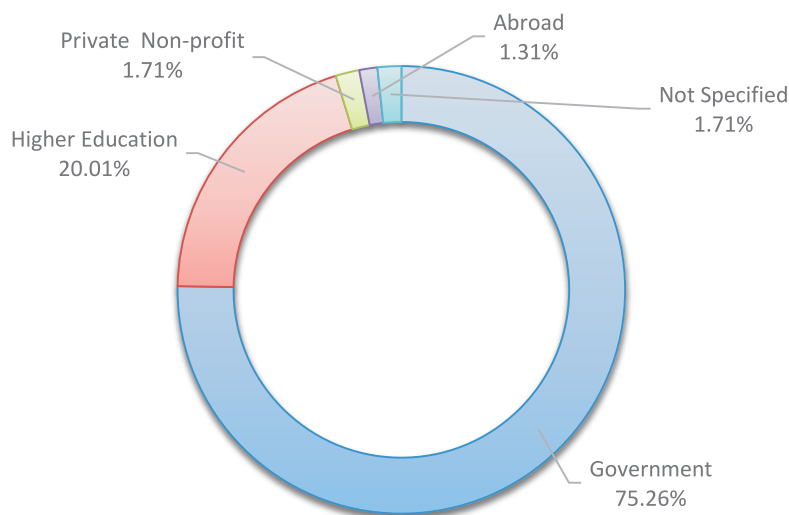


Figure 2.5. R&D expenditure by source of funds(2013)
Source: PCST R&D Survey 2013-14

Govt. R&D Organizations Receive 67.06% of Total Funding

There are two main sectors where R&D is performed in Pakistan i.e. Government R&D organizations and higher educational institutions. Government R&D organizations receive about two times more R&D funding than higher educational institutions.

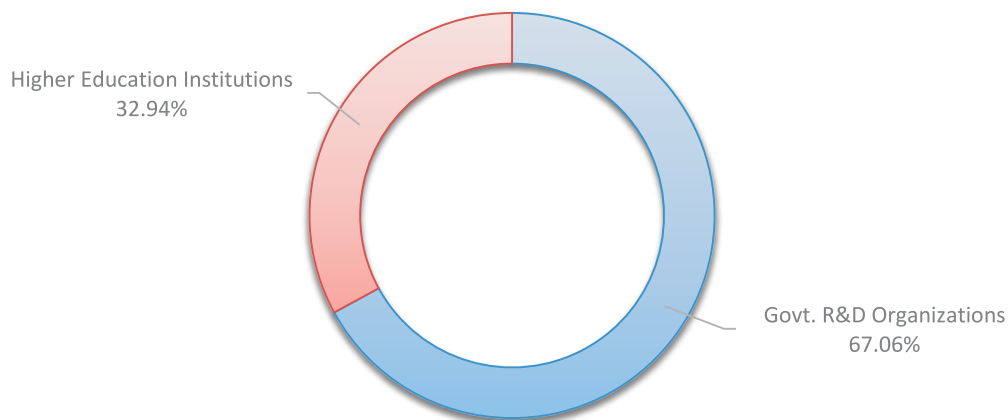


Figure 2.6. R&D expenditure by sector of performance (2013)
Source: PCST R&D Survey 2013-14

Low
GERD/GDP
Ratio
0.29%

The R&D expenditure, also termed as gross expenditure on research and development (GERD), of Pakistan as percent of GDP is much less as compared to the developed countries as well as the leading developing countries. It is also much less than the GERD/GDP ratio (1%) recommended by UNESCO.

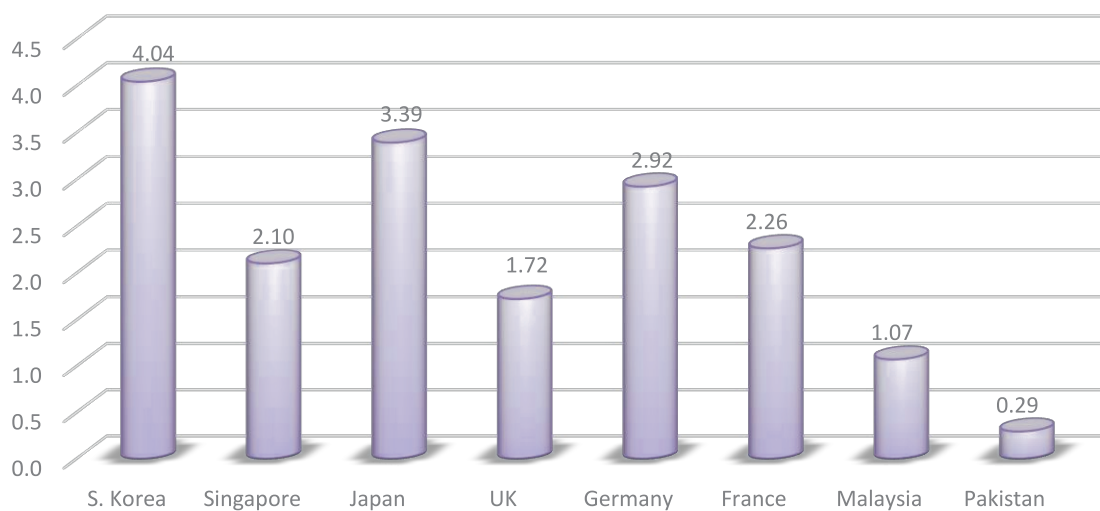


Figure 2.7. Comparison of R&D expenditure (as percent of GDP) of Pakistan with some other countries (2013)

Source: PCST R&D Survey 2013-14, UIS Online Database

3. Bibliometric Indicators

Bibliometric indicators are generally used in making systematic comparison of scientific output and to assess the status of S&T across institutions and geographical regions and countries. They provide quantitative basis to measure the “health of science” in a country, and its strengths and weaknesses on comparative basis. Two types of indicators, namely absolute and relative indicators are generally used for bibliometric analysis. Publications count, journals count, citations count, institution count, etc. are the examples of bibliometric indicators. These are used frequently for bibliometric analysis. The count of scientific papers published in peer-reviewed journals provides an estimate of the volume of research activity and related knowledge generation.

An example of the 'institution count' indicator is the number of universities in Pakistan. At the time of creation of Pakistan in 1947, there were only two universities in Pakistan. However, during the last 15 years the number of universities has increased sharply, both in public and private sector, and at present there are 160 universities in the country. During the period 2000-2013 around 8,456 doctoral degrees had been awarded at Pakistani universities. The number of degrees per year has been skyrocketed in recent years indicating improvement in the performance of universities which are an important source of knowledge creation in the knowledge based economies.

Publication profile is an important indicator of the scientific activity of a country. The research publications are major and most significant indicator of research productivity. In this section of the document, the trend in publication activity in Pakistan is presented taking a span of 18 years (1996-2013). The number and quality of publications by a country indicates its contribution towards scientific development. The significant and visibility of published scientific articles is usually evaluated by the number of citations the article receives in the years following publication. The number of citations can be seen as a direct measure of the resonance or impact of publication on the scientific community. Average citations per articles of an institution or a country indicate the visibility of these articles in the international scientific community. The count of scientific publications in different fields of research shows the strengths and weaknesses of a country in particular areas. In the present document break down of the overall publication activity of Pakistan into main subject areas is also presented to characterize country's research profile.

Number of Universities / DAIs
160

The number of universities / degree awarding institutions (DAIs) in Pakistan has increased very rapidly during the last 15 years, especially after the establishment of the Higher Education Commission in 2002.

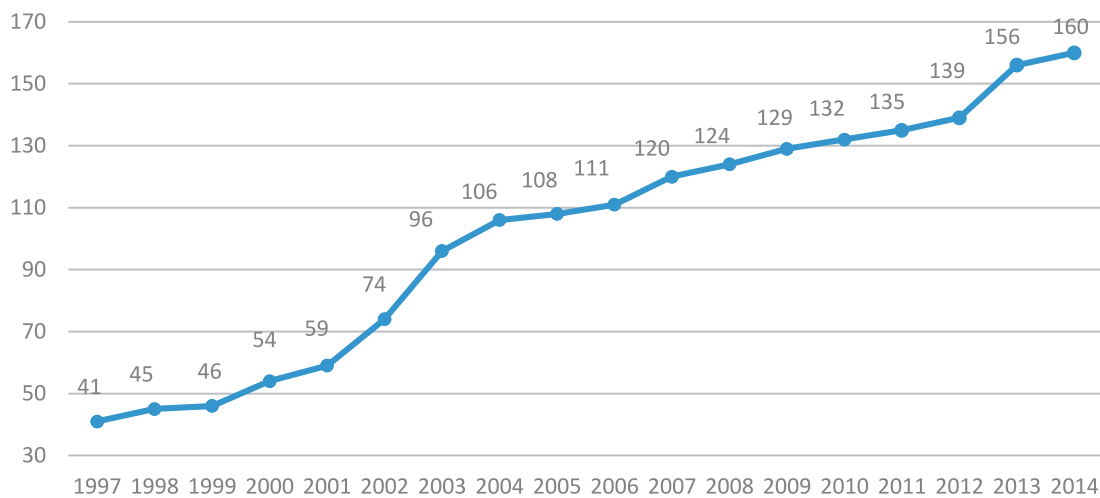


Figure 3.1. Total number of universities / degree awarding institutions (DAIs) in Pakistan (1997-2014)

Source: HEC Website

PhDs produced per year (average)
530

The number of PhDs produced by Pakistani universities has been increasing from 2000 to 2011. In 2011, maximum number of PhDs was produced (954). Since then a slight decline in the production of PhDs by Pakistani universities is being observed.

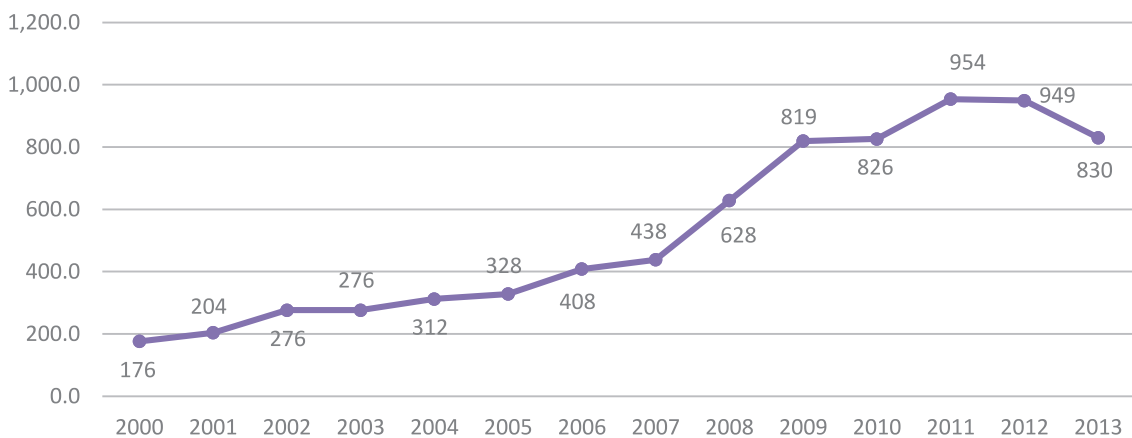


Figure 3.2. Number of PhDs produced by Pakistani universities (2000-2013)

Source: HEC Website

Maximum PhDs in Social Sciences 25.42%

Pakistani universities have produced maximum number of PhDs, during the period 2000 and 2013, in the field of Social Science (24.24%) followed by Physical Sciences (21.88%) and Biological & Medical Sciences (20.67%).

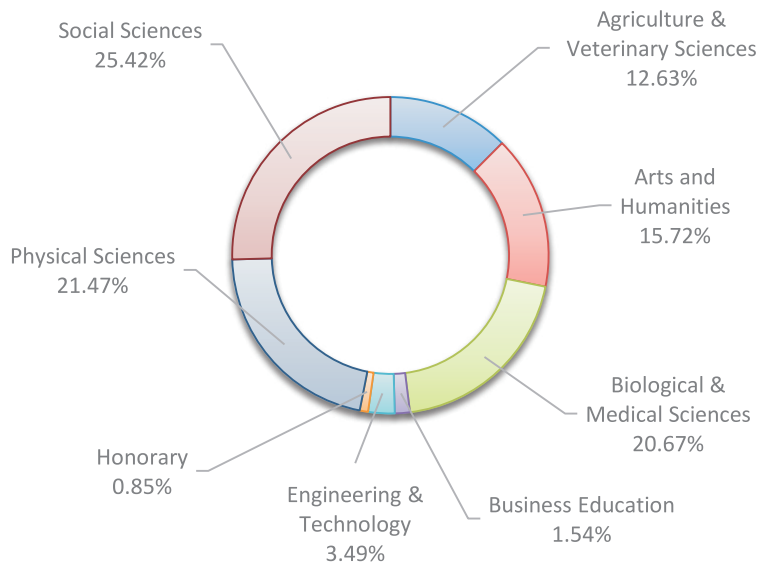


Figure 3.3. Field-wise production of PhDs by Pakistani universities
Source: HEC Website

Research Publications in 2013 10,915

The number of research publications by Pakistani scientists in international journals show consistent increase since 1996. However, this increase is more significant after 2002.

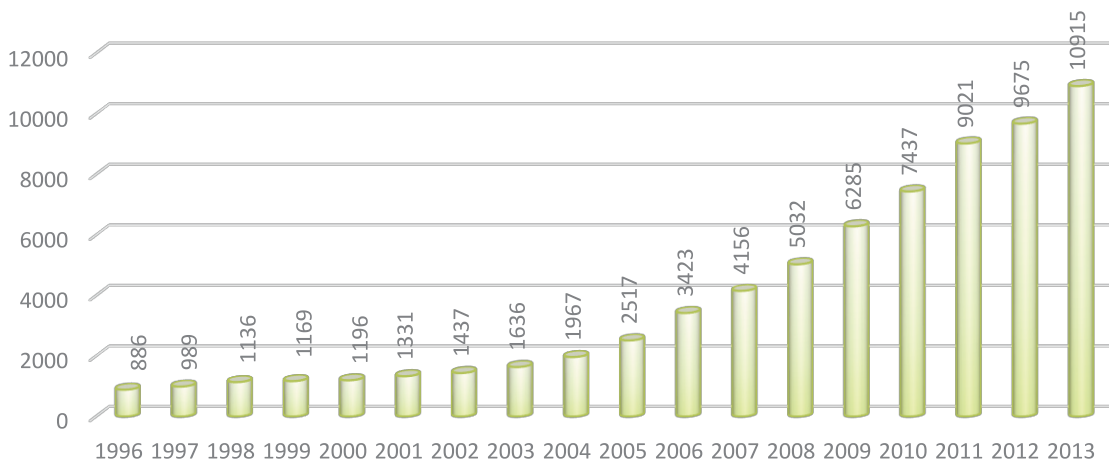


Figure 3.4. Research publications per year by Pakistani scientists in international journals (1996-2013)
Source: Scimago Website

Average CPY for 18-Year Period (1996-2013)
0.79

The highest (1.19) average 'citations per publication per year (CPY)' to the research publications made during any one year were for the publications made during 2008. The 'average citations per publication per year' were only 0.34 for publications made during 2013 but it may not reflect the true picture because one year is a too small period for a publication to attract citations.

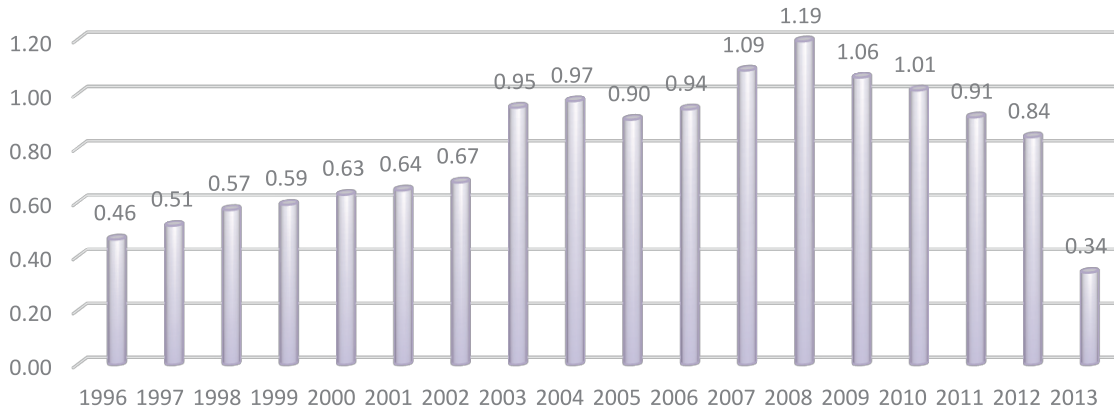


Figure 3.5. Average 'citations per publication per year (CPY)' of research publications of Pakistani scientists in international journals (1996-2013)

Source: Scimago Website

International Collaboration of Pakistan's Publications
39.19 %

The international collaboration in research publications by Pakistani scientists in international journals has ranged from about 20% to about 39%. It was the highest (39.19%) in the year 2013.

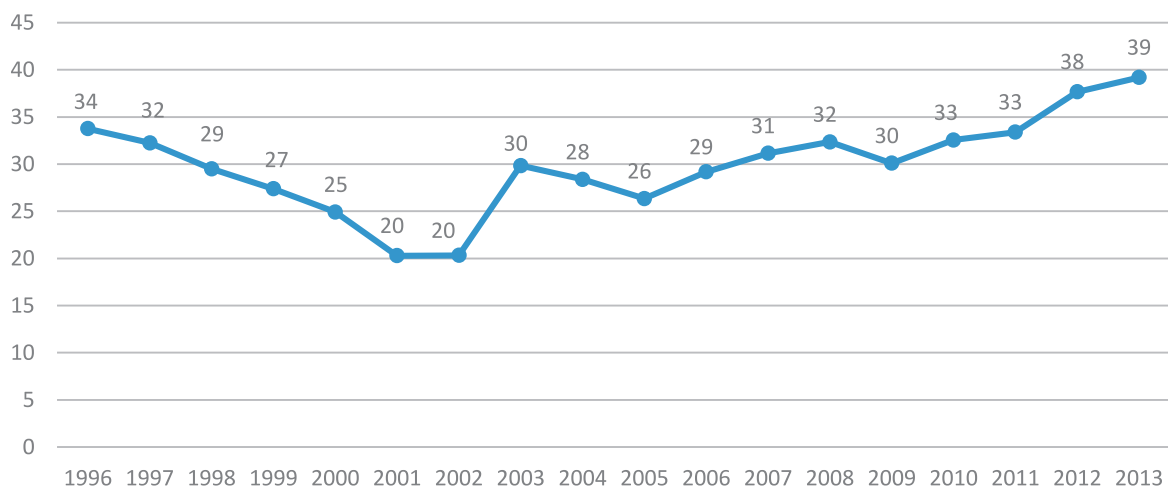


Figure 3.6. International collaboration (%) in research publications of Pakistani scientists in international journals (1996-2013)

Source: Scimago Website

Maximum
Number of
Publications
in Medicine
20,957

Total publications in international journals by Pakistani scientists during the 18-year period (1996-2013) were 72,802. The maximum number of publications were made in the field of Medicine (20,957) followed by Agricultural & Biological Sciences (12,397), Chemistry (8,636) and Engineering (8,536). The publications in Medicine also received highest total citations (103,208). However, the highest citations per publication (CPP) were received by the publications in the field of Neuroscience which were 10.75.

Table 1. Field-wise publications of Pakistani scientists in international journals for the period 1996-2013

Source: Scimago Website

S.No.	Subject	Publications	Citations	CPP	H-Index
1	Agricultural and Biological Sciences	12,397	57,594	4.65	63
2	Arts and Humanities	425	3,145	7.40	27
3	Biochemistry, Genetics and Molecular Biology	5,984	51,381	8.59	80
4	Business, Management and Accounting	870	1,285	1.48	16
5	Chemical Engineering	1,875	14,528	7.75	47
6	Chemistry	8,636	45,907	5.32	60
7	Computer Science	6,685	12,512	1.87	35
8	Decision Sciences	373	1,030	2.76	14
9	Dentistry	100	694	6.94	14
10	Earth and Planetary Sciences	1,486	8,706	5.86	39
11	Economics, Econometrics and Finance	802	1,937	2.42	20
12	Energy	1,257	5,761	4.58	27
13	Engineering	8,536	30,036	3.52	56
14	Environmental Science	2,977	23,008	7.73	55
15	Health Professions	225	1,260	5.60	19
16	Immunology and Microbiology	2,178	20,529	9.43	54
17	Materials Science	5,815	25,772	4.43	48
18	Mathematics	4,444	21,634	4.87	48
19	Medicine	20,957	103,208	4.92	92
20	Multidisciplinary	1,933	5,932	3.07	24
21	Neuroscience	337	3,624	10.75	29
22	Nursing	855	3,368	3.94	27
23	Pharmacology, Toxicology and Pharmaceutics	3,139	22,816	7.27	53
24	Physics and Astronomy	8,111	49,123	6.06	65
25	Psychology	229	1,557	6.80	22
26	Social Sciences	3,055	6,862	2.25	31
27	Veterinary	833	3,649	4.38	23
	Total	70,208	328,281	4.68	130

World Share of Pakistani Publications 0.43%

The share of Pakistani research publications in the total World publications has increased over the years from 1996 to 2013. The research publications by Pakistani scientists received maximum share in 2013 which was 0.43 percent.

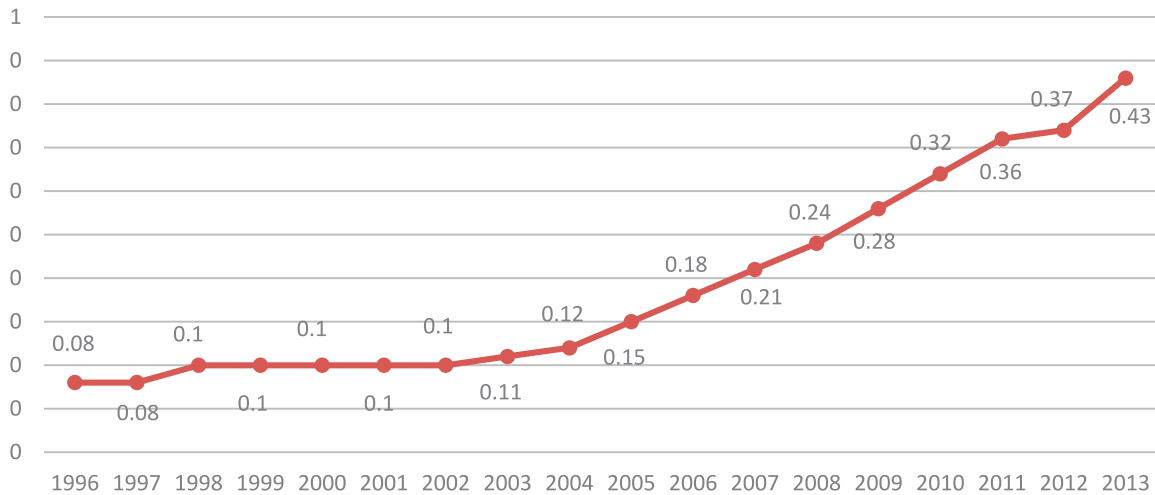


Figure 3.7. Share (%) of the Pakistani research publications in the total World publications (1996-2013)

Source: Scimago Website

5 times Less Publications than Turkey

Pakistan's total publications during the period 1996-2013 are five times less than Turkey and three times less than Iran. However, it has more publications than countries like Indonesia and Bangladesh.

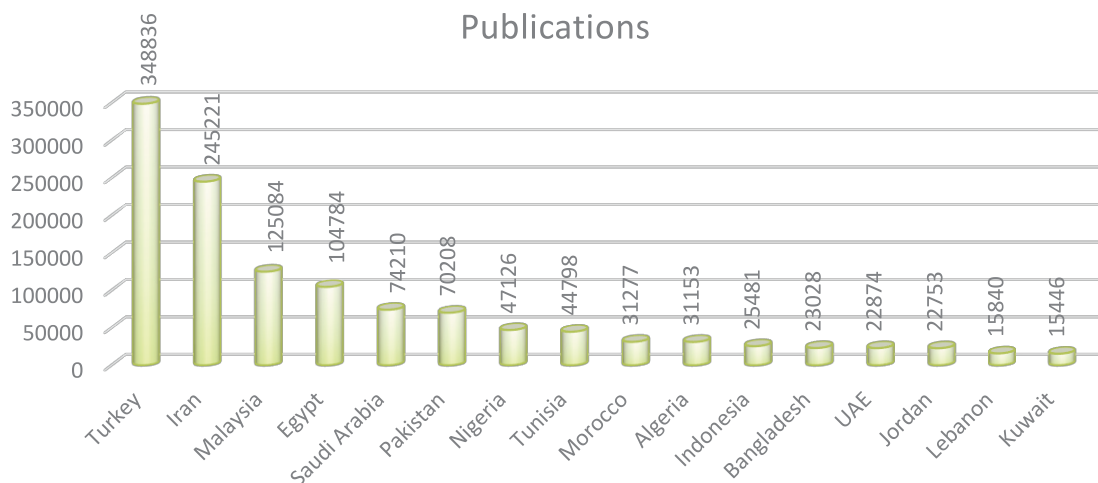


Figure 3.8. International comparison of total Pakistani publications for the period 1996-2013

Source: Scimago Website

7 times Less Citations than Turkey

Total citations of the Pakistani publications during the period 1996-2013 were seven times less than Turkey and three times less than Iran. However, it has more publications than countries like Nigeria, Tunisia, Indonesia, Bangladesh etc.

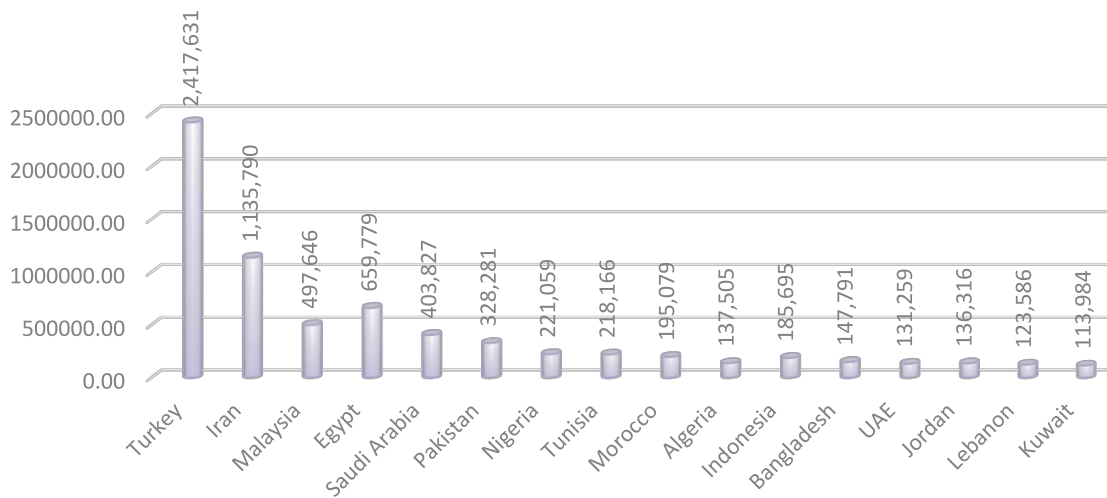


Figure 3.9. International comparison of total citations of Pakistani publications for the period 1996-2013

Source: Scimago Website

Average Citations per Publication (1996-2013) 6.95

Pakistan received average 6.95 citations per publication during the period 1996-2013 which were less than all the other countries included in the comparison except than Nigeria which has slightly less citations per publication than Pakistan.

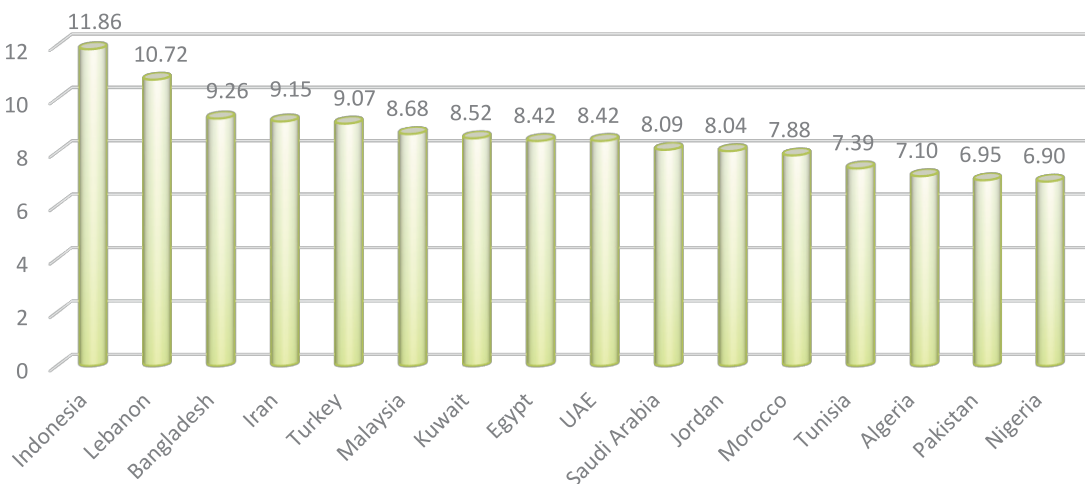


Figure 3.10. International comparison of citations per publication of Pakistani publications for the period 1996-2013

Source: Scimago Website

H-index of
Pakistani
Publications
130

H-index of Pakistani publications during the period 1996-2013 was 130 which was less than Turkey, Iran, Malaysia etc. However, it was higher than countries like Nigeria, Tunisia, Indonesia, Bangladesh etc.

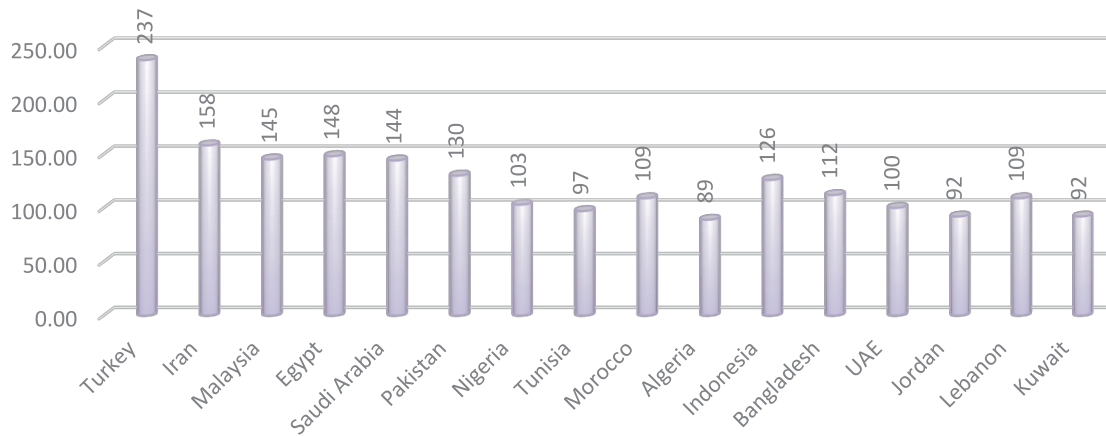


Figure 3.11. International comparison of H-index of Pakistani publications for the period (1996-2013)

Source: Scimago Website

4. Intellectual Property Indicators

Intellectual property refers to creations of the mind including inventions, literary and artistic works, and symbols, names, images, and designs used in commerce. It is divided into two categories which are industrial property and copyright. Industrial property includes inventions (patents), trademarks, industrial designs and geographic indications. Copyright includes literary and artistic works such as novels, poems and plays, films, musical works, artistic works such as drawings, paintings, photographs and sculptures, and architectural designs. This chapter presents intellectual property scenario in Pakistan by giving three main indicators i.e. patents, trademarks and industrial designs, which are more related to R&D and innovation.

A **patent** is an exclusive right granted for an invention. Generally speaking, a patent provides the patent owner with the right to decide how or whether the invention can be used by others. In exchange for this right, the patent owner makes technical information about the invention publicly available in the published patent document.

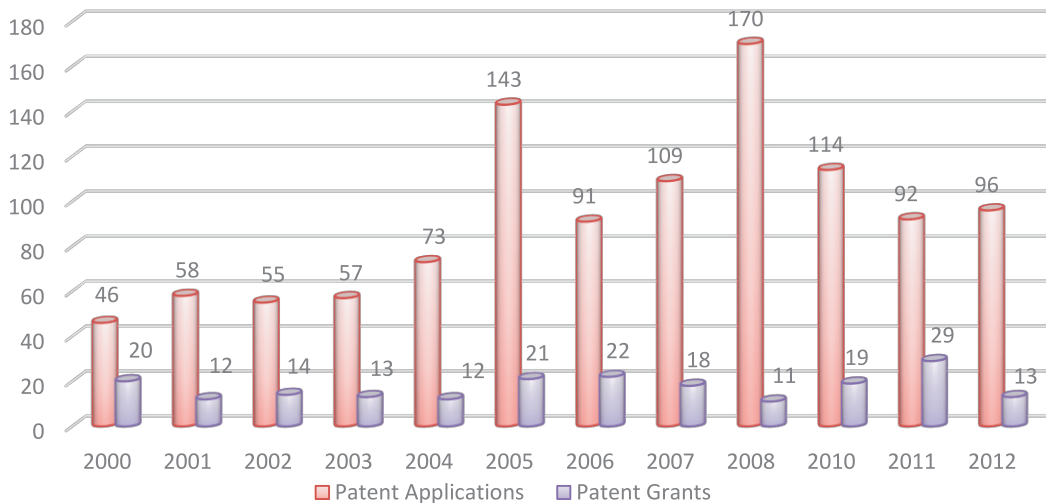
A **trademark** is a sign capable of distinguishing the goods or services of one enterprise from those of other enterprises. Trademarks date back to ancient times when craftsmen used to put their signature or "mark" on their products. A Trademark is a mark which distinguishes the goods and services of one trader from those of another. A mark includes words, logos, pictures, names, letters, numbers or a combination of these. Trademarks is used as a marketing tool to enable customers in recognizing the product of a particular trader.

An **industrial design** constitutes the ornamental or aesthetic aspect of an article. A design may consist of three-dimensional features such as the shape or surface of an article, or two-dimensional features, such as patterns, lines or colour.

Patent, Trademark or industrial design applications filed at an office are classified as resident or non-resident applications according to the residency of the first-named applicant. A **resident application** refers to an application filed with an office by an applicant residing in the country over which that office has jurisdiction. For example, an application filed with an office in Pakistan by an applicant residing in Pakistan is considered a resident application. Resident applications are referred to as domestic applications. Similarly, a **non-resident application** refers to an application filed with an office of a given country by an applicant residing in another country. For example, an application filed with an office in Pakistan by an applicant residing in France is a non-resident application for Pakistan.

Average Resident Patent Grants per year 17

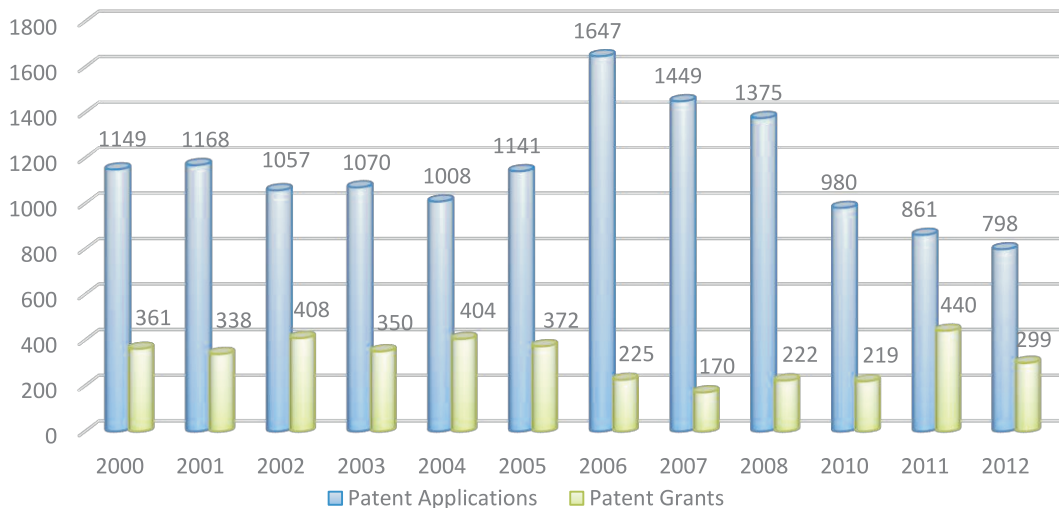
Maximum number (170) of resident patent applications was filed in 2008 while maximum number of patents (29) to resident applicants was granted in 2011 during the period 2000 to 2012.



*Data for 2009 not available
Figure 4.1. Resident patent applications and grants for Pakistan (2000-2012)
 Source: WIPO Website

Average Non-resident Patent Grants per year 317

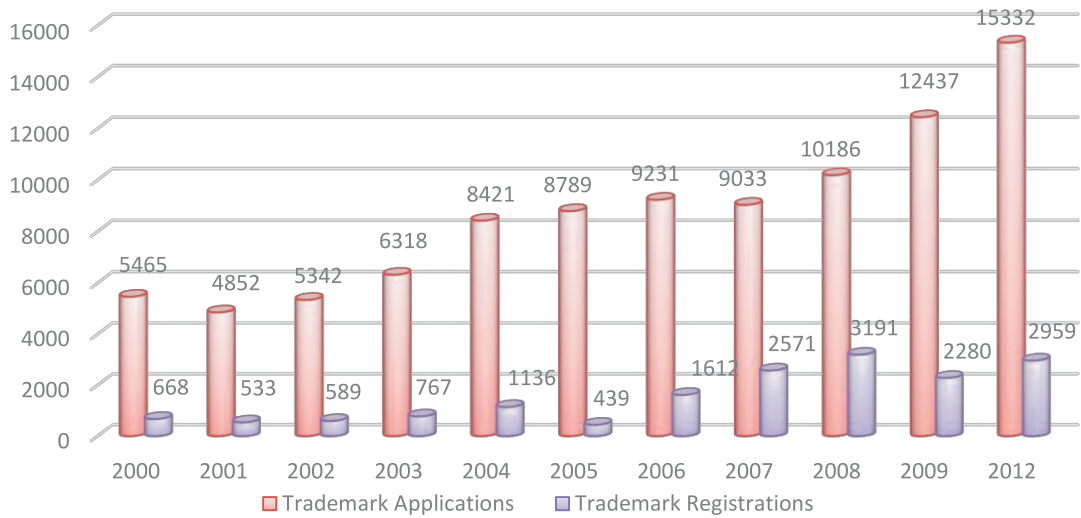
Maximum number (1647) of non-resident patent applications was filed in 2006 while maximum number of patents (440) to non-resident applicants was granted in 2011 during the period 2000 to 2012.



*Data for 2009 not available
Figure 4.2. Non-resident patent applications and grants for Pakistan (2000-2012)
 Source: WIPO Website

Ave. Resident Trademark Registrations per year
1522

Maximum number (15,332) of resident trademark applications was filed in 2012 while maximum number of trademarks (3,191), against resident applications, was registered in 2008 during the period 2000 to 2012.

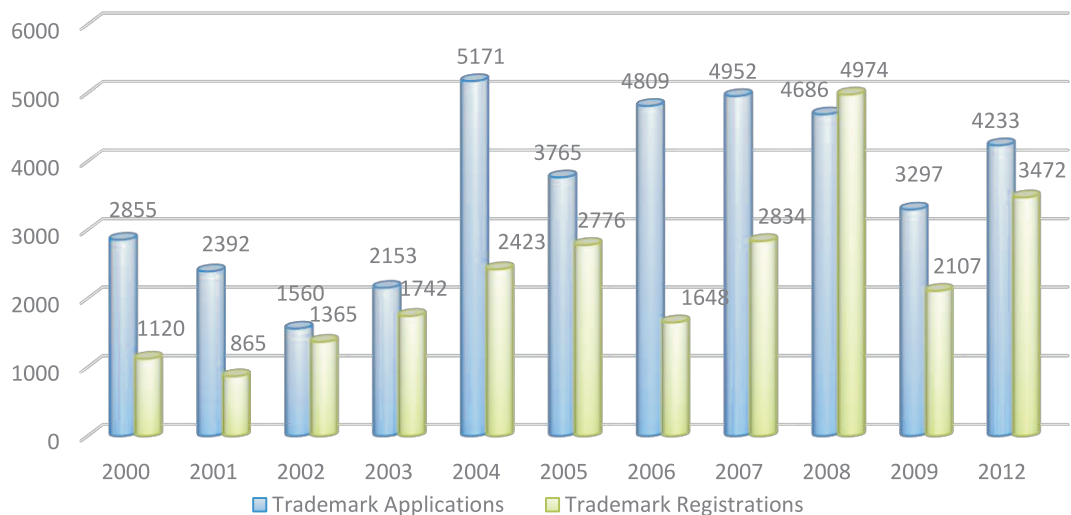


*Data for 2010 and 2011 not available

Figure 4.3. Resident trademark applications and registrations for Pakistan (2000-2012)
Source: WIPO Website

Average Non-resident Trademark Registrations per year
2302

Maximum number (5,171) of non-resident trademark applications was filed in 2004 while maximum number of trademarks (4,974) against non-resident applications was registered in 2008 during the period 2000 to 2012.

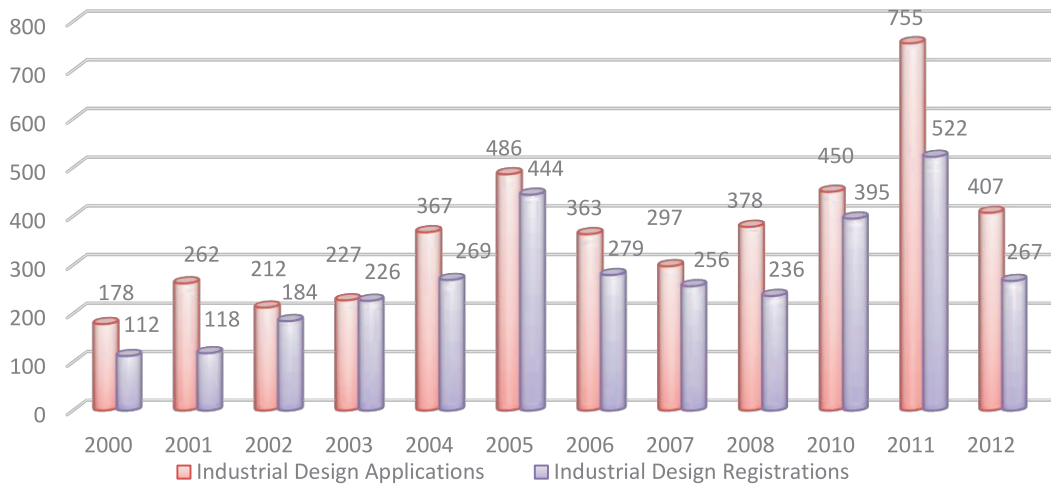


*Data for 2010 and 2011 not available

Figure 4.4. Non-resident trademark applications and registrations for Pakistan (2000-2012)
Source: WIPO Website

Ave. resident Industrial Design Registrations per year
276

Maximum number (755) of resident industrial design applications was filed in 2011 and maximum number of industrial design registrations (522), against resident applications, was also granted in the same year during the period 2000 to 2012.

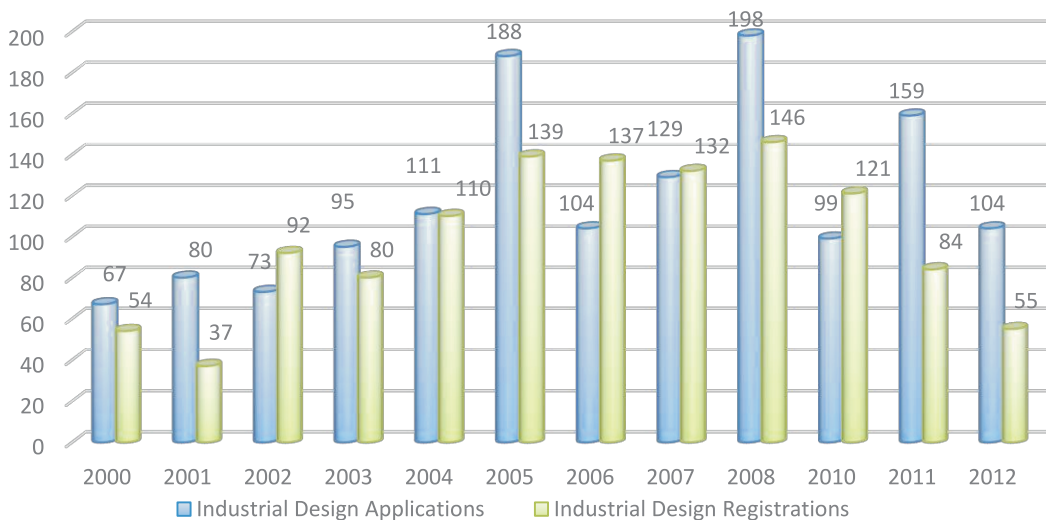


*Data for 2009 not available

Figure 4.5. Resident industrial design applications and registrations for Pakistan (2000-2012)
Source: WIPO Website

Ave. Non-resident Ind. Design Registrations per year
99

Maximum number (198) of non-resident industrial design applications was filed in 2008 and maximum number of industrial design registrations (146), against non-resident applications, was also granted in the same year during the period 2000 to 2012.



*Data for 2009 not available

Figure 4.6. Non-resident industrial design applications and registrations for Pakistan (2000-2012)
Source: WIPO Website

Resident Patent Applications per million Population
1.0

Pakistan's resident patent applications per million population are much less than all the other countries included in the comparison. Pakistan has only one resident patent applications per million population against the Denmark's 539 and Norway's 312 or even Malta's 74 patent applications.

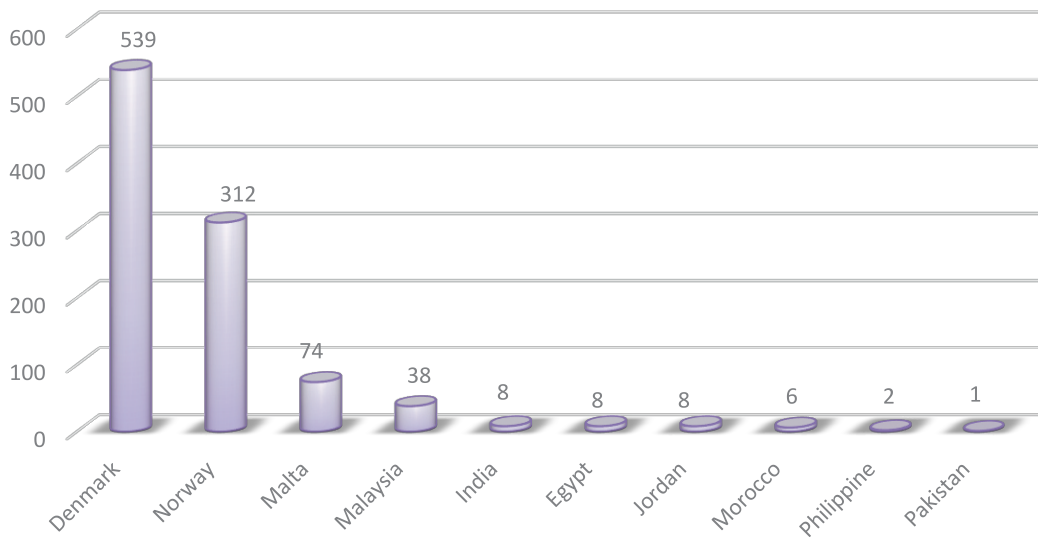


Figure 4.7. International comparison of resident patent applications per million population of Pakistan (2012)
Source: WIPO Website

5. ICT Indicators

The World Bank defines ICTs as “the set of activities which are facilitated by electronic means of processing, transmission and display of information”. The ICT indicators discussed in the present section provide an indication of the available ICT infrastructure and individuals' access to basic ICTs and capture ICT intensity and usage. ICT indicators have been used in many studies and indices, such as Technology Achievement Index, as important indicators of technology development capacity of a country.

Fixed-telephone subscriptions per 100 inhabitants

Fixed-telephone subscriptions refer to the sum of active analogue fixed-telephone lines, voice-over-IP (VoIP) subscriptions, fixed wireless local loop (WLL) subscriptions, ISDN voice-channel equivalents and fixed public payphones.

Mobile / cellular telephone subscriptions per 100 inhabitants

Mobile-cellular telephone subscriptions refer to the number of subscriptions to a public mobile-telephone service which provides access to the public switched telephone network (PSTN) using cellular technology.

International internet bandwidth (kilobits/s) per internet user

International Internet bandwidth refers to the total used capacity of international internet bandwidth, in kilobits per second (kilobit/s). It is measured as the sum of used capacity of all Internet exchanges offering international bandwidth.

Percentage of households with a computer

A computer refers to a desktop computer, a laptop computer or a tablet or similar handheld computer. It does not include equipment with some embedded computing abilities, such as smart TV sets, and devices with telephony as a main function, such as mobile or smart phones. Household with a computer means that the computer is available for use by any member of the household at any time.

Percentage of households with internet access

The internet is a worldwide public computer network. It provides access to a number of communication services, including the world wide web, and carries e-mail, news, entertainment and data files, irrespective of the device used (not assumed to be only a computer – it may also be a mobile phone, games machine, digital TV etc.). Access can be via a fixed or mobile network. Household with internet access means that the device to access the internet is available for use by any member of the household at any time.

Teledensity
(Total)
75.2%
(Mobile)
71.7%

Total and mobile teledensities (%) i.e. subscriptions per 100 inhabitants, in Pakistan both have increased significantly during the period 2007 to 2013.

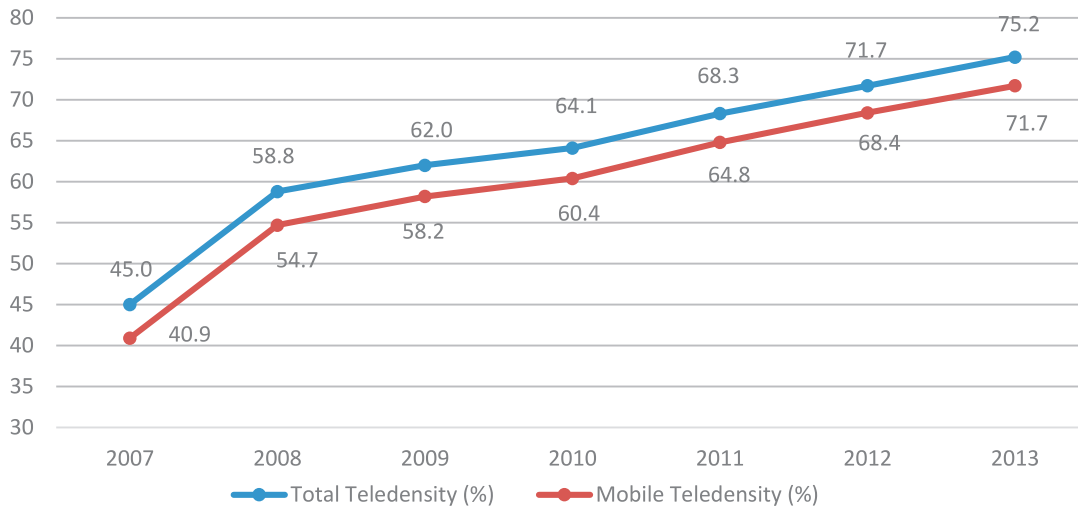


Figure 5.1. Total and mobile teledensities (subscriptions per 100 inhabitants) in Pakistan (2007-2013)
Source: PTA Website

Teledensity
(FLL)
1.6%
(WLL)
1.9%

Percent fixed local loop (FLL) teledensity (subscriptions per 100 inhabitants) in Pakistan shows continuous decreasing trend from 2007 to 2013. In contrast, wireless local loop (WLL) teledensity shows a continuous increasing trend during the same period.

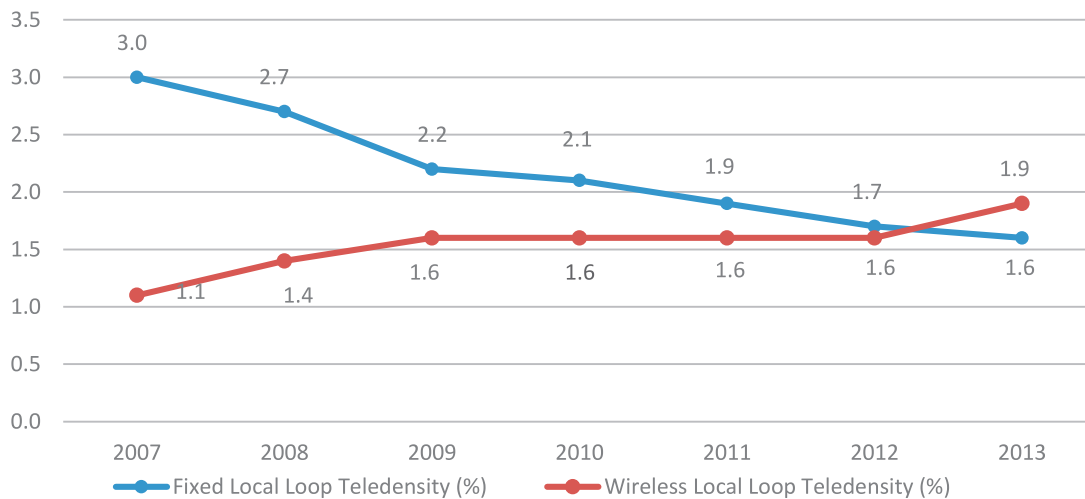


Figure 5.2. Fixed and wireless local loop teledensities (subscriptions per 100 inhabitants) in Pakistan (2007-2013)
Source: PTA Website

Total Cellular Subscriptions 128.9 million

Cellular (mobile phone) subscribers in Pakistan has been consistently increasing and the total subscription was reached to 128.9 million in 2013 from 63.2 million in 2007.

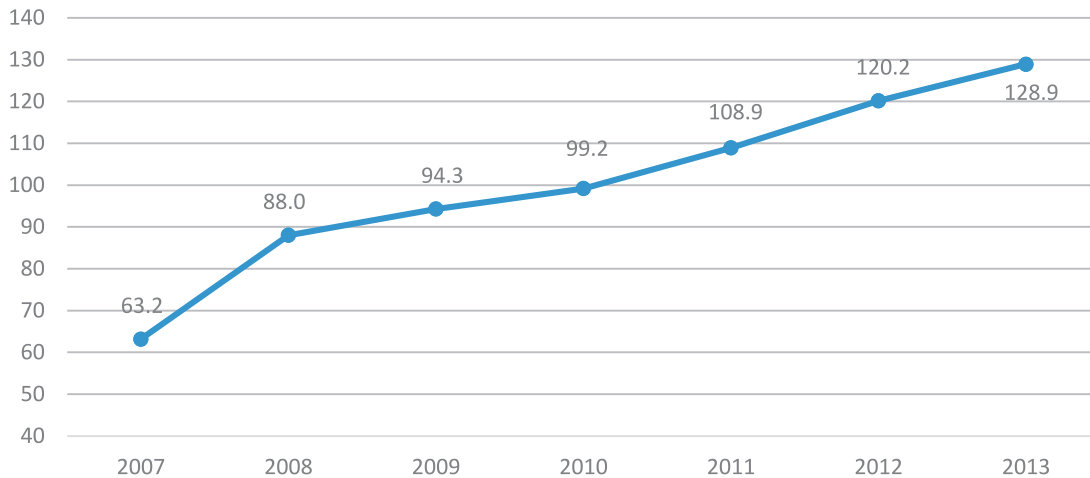


Figure 5.3. Total cellular subscriptions (millions) in Pakistan (2007-2013)
 Source: PTA Website

Much Less Fixed & Mobile Teledensity

Although the total mobile subscriptions in Pakistan have been on the rise during the past decade or so, Pakistan still lacks behind in not only fixed but also in mobile teledensity i.e. subscription per 100 inhabitants, than many other countries.

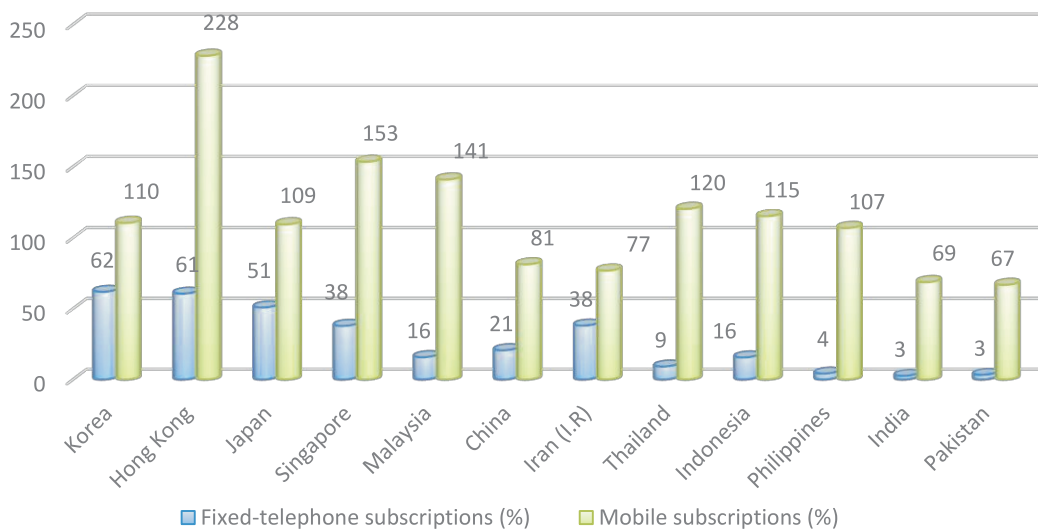


Figure 5.4. International comparison of fixed and mobile telephone subscriptions per 100 inhabitants (2012)
 Source: ITU Website

Households with Computer
12.5%
Internet Access
8.3%

Households in Pakistan which have computer or access to internet are much less than most of the other countries included in the comparison. However, it has more number of households with computers than India and more households with internet access than Indonesia.

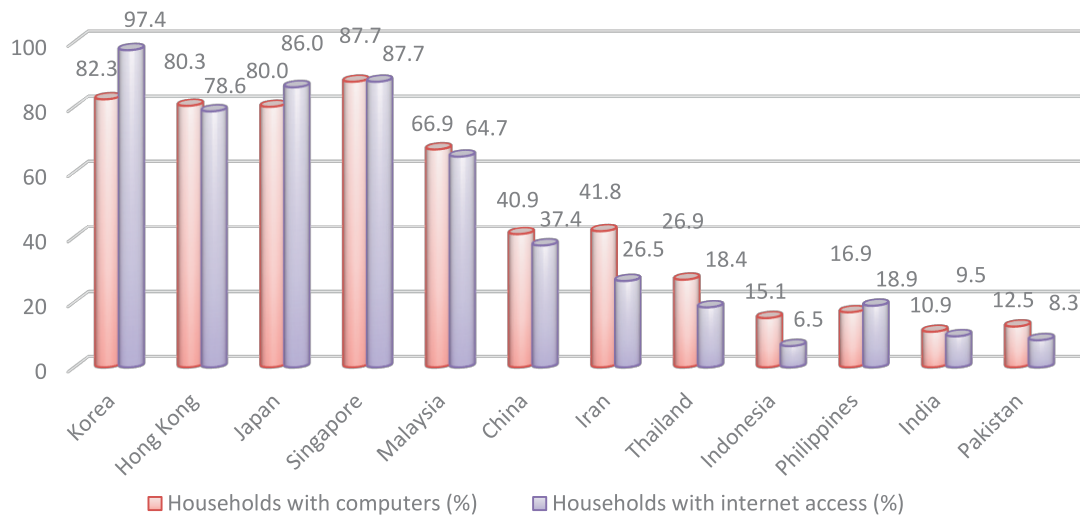


Figure 5.5. International comparison of households with computer and internet access (2012)

Source: ITU Website

Bandwidth per Internet user
(kilobit/s)
7.3

Pakistan has higher international internet bandwidth (kilobit/s) per internet user than Iran, China and India. Hong Kong has huge bandwidth which is about 170 times higher than Pakistan.

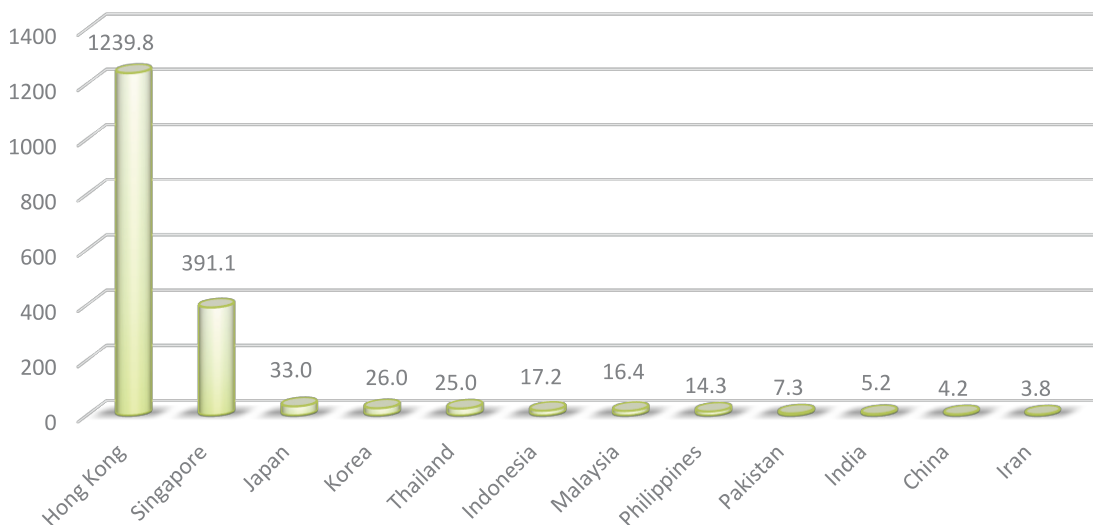


Figure 5.6. International comparison of international internet bandwidth (kilobit/s) per internet user (2012)

Source: ITU Website

6. Basic Socioeconomic Indicators

In this chapter, some basic socioeconomic indicators are presented to supplement STI indicators for more holistic picture of the country.

Population

Pakistan is the 6th most populous country in the world with an estimated population of 184.40 million in 2012-2013. The growth rate of population during 2012-2013 was 2.0 percent. At present growth rate, it is expected that Pakistan will attain 5th position in the World in terms of total population till 2050.

Gross Domestic Product (GDP)

Pakistan's economy continues to face numerous domestic and external shocks from 2007 onwards. The economy of Pakistan during the last five years grew on average at the rate of 2.9 percent per annum. GDP growth has been stuck at a level, which is half of the level of Pakistan's long-term trend potential of about 6.5 percent per annum and is lower than what is required for sustained increase in employment and income, and a reduction in poverty. However, Pakistan has the potential to move towards which is needed to generate adequate employment and meaningful poverty reduction provided that issues like terrorism and power crises are addressed and political stability is achieved.

Per capita income

Per capita income is regarded as one of the key indicators of economic well-being over a period of time. With the emergence of more analytical tools and sophisticated indicators, numerous indicators and measures of well being have been added to economic literature. However, none of these could undermine the importance of per capita income in providing simple reflection of the average level of prosperity in the country or average standards of living of the people in a country. Per capita income is defined as Gross National Product (GNP) at market price divided by the country's population.

Expenditure on education as percent of GDP

Public expenditure on education in Pakistan lies on the fringes of 2 percent of GDP. However, in the National Education Policy-2009, it is stated that the education expenditure will be increased to 7% of GDP. Public expenditure on education is an important indicator to assess government's commitment to provide education to its people. It is important because it is a fundamental right of people to get opportunities of education. But it is also important because it reflect country's capacity to participate in knowledge-based economy.

Total Population of Pakistan
184.4 million

Pakistan is the 6th populous country in the World and its population is increasing at a rate of 2 percent. If continued at this growth rate, Pakistan will be 5th most populous country in the World till 2050.

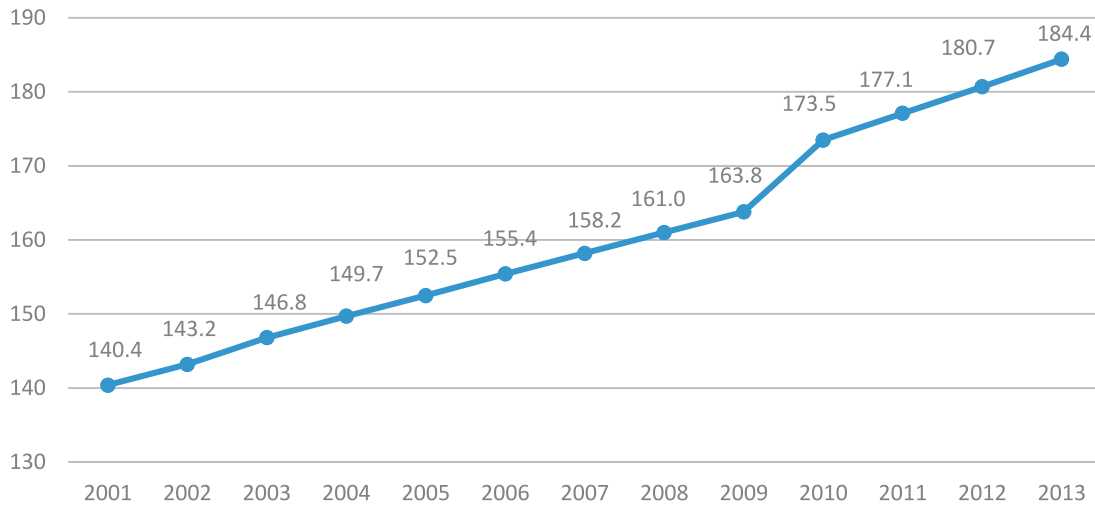


Figure 6.1. Population (million) of Pakistan (2001-2013)

Source: Pakistan Economic Survey 2012-13

Males
51.06%
Females
48.31%

Females are about half of the population of Pakistan, therefore, this portion of the population needs to be effectively utilized for the socioeconomic development of the country, especially in the field of science and technology.

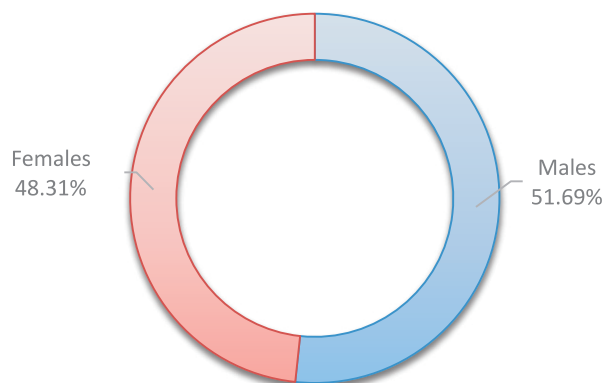


Figure 6.2. Percentage of males and females in total population of Pakistan (2013)

Source: Pakistan Economic Survey 2012-13

Labour force
(Total)
60.5 M
(Employed)
56.9 M

Total labour force and employed labour force in Pakistan have increased consistently over the years. Both the labour force and employed labour force increased about 50 percent in 2013 as compared to 2001.



Figure 6.3. Total labour force and employed labour force (million) of Pakistan (2001-2013)

Source: Pakistan Economic Survey 2012-13

GDP of Pakistan
(Rs. million)
22,909,079

Historically Pakistan's overall economic output (GDP) has grown every year since a 1951 and it is the 26th largest economy in the world in terms of purchasing power parity (PPP), and 44th largest economy in terms of nominal GDP.

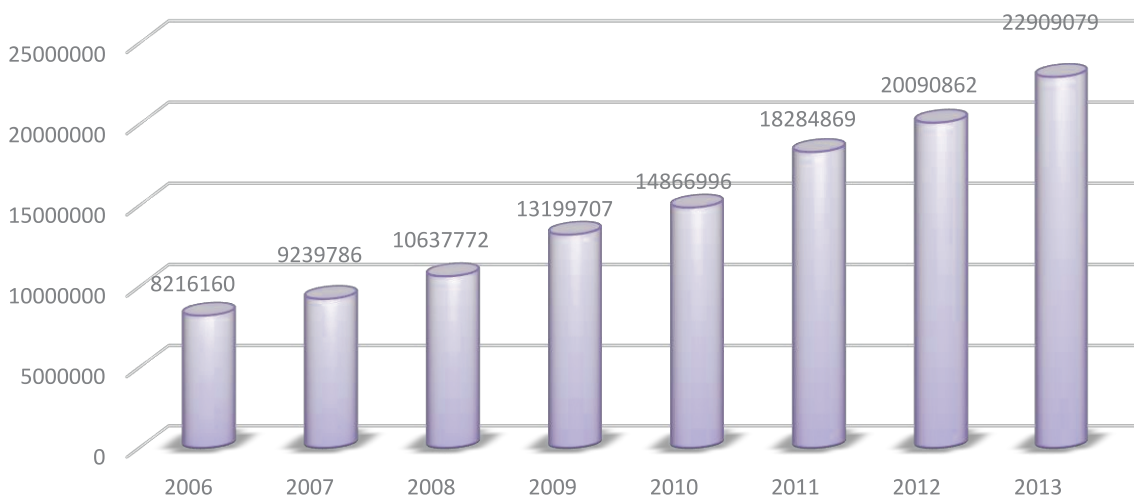


Figure 6.4. GDP (million) of Pakistan at current market price (2006-2013)

Source: PBS Website

Per Capita Income (PPP\$)
1,368

Per capita income of Pakistan has increased from PPP\$ 897 in 2006 to PPP \$1,368 in 2013. However, Pakistan is still categorized in the 'lower middle income group' of countries in the classification of countries based on income level.

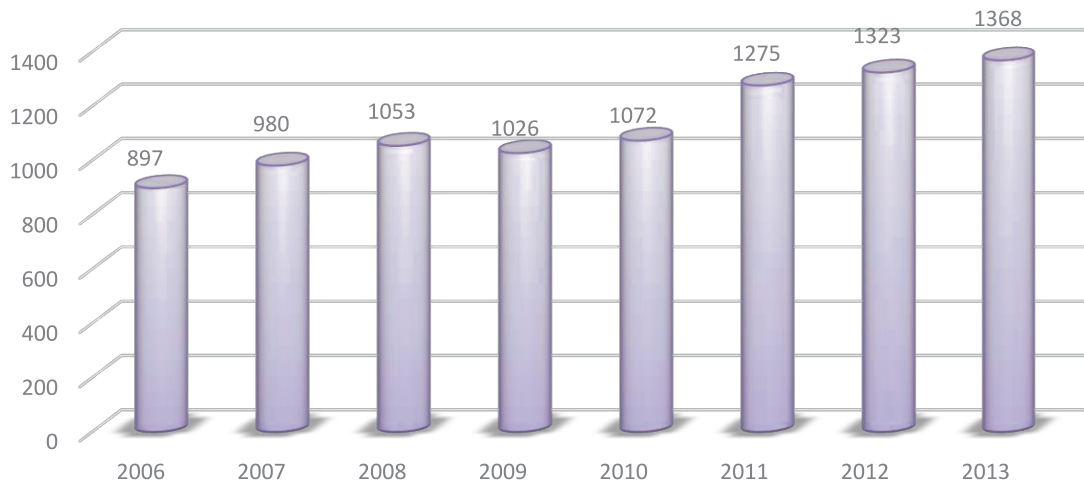


Figure 6.5. Per capita income (PPP\$) of Pakistan (2006-2013)

Source: Pakistan Economic Survey 2012-13

GDP Growth rate of Pakistan
3.6%

Historically Pakistan's overall economic output (GDP) has grown every year since a 1951 and it is the 26th largest economy in the world in terms of purchasing power parity (PPP), and 44th largest economy in terms of nominal GDP.

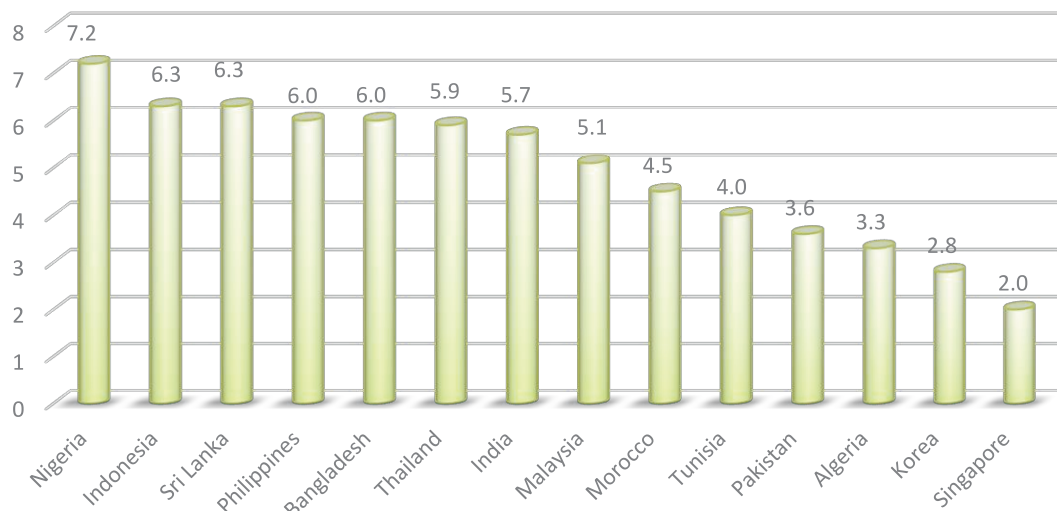


Figure 6.6. International comparison of GDP growth rate of Pakistan (2013)

Source: Pakistan Economic Survey 2012-13

Expenditure
on Education
2%

Expenditure on education showed increase from 2001 to 2007, when it reached to 2.4 percent of GDP but after that it showed decrease and in 2012, the expenditure on education was 2 percent of GDP.

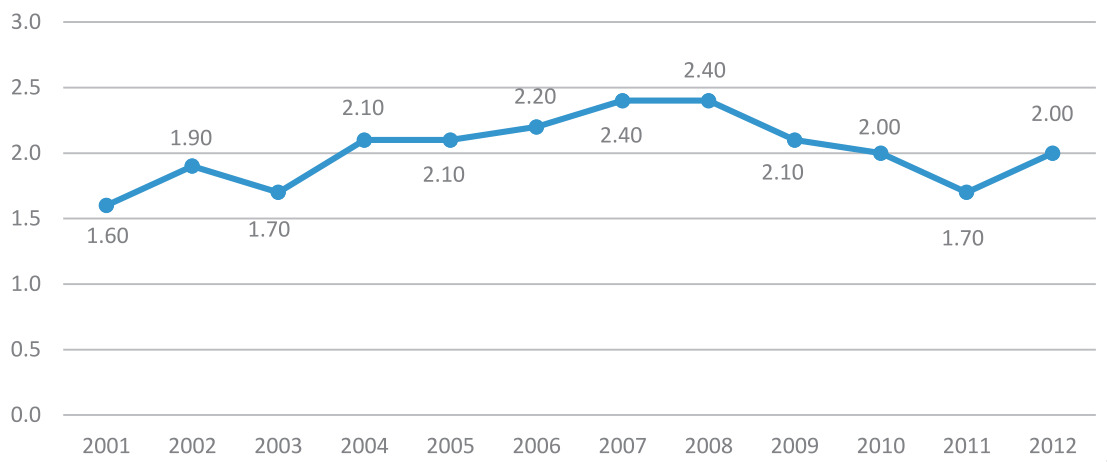


Figure 6.7. Expenditure on Education as percent of GDP in Pakistan (2001-2012)

Source: Pakistan Economic Survey 2012-13

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