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Identifying the patent trend, licensing pattern and geographical landscape analysis of the Council for Scientific & Industrial Research (CSIR) of India between 2000 and 2011

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ABSTRACT

The article analyses trends and patterns of the Indian Council for Scientific & Industrial Research (CSIR)'s, national and international patenting activities which are In-force as of August, 2013. CSIR was chosen as being India's largest public funded research and development (R&D) organization covering a wide canvas of scientific disciplines. The article reports on a decade of national and international patent filing and granting trends along with the number of active patents In-force and Patent Cooperation Treaty (PCT) filing patterns. In addition, the article discusses the geographical distribution and Right to Information (RTI) responses related to licensing activities of CSIR patents. The article reports the bibliometric study of patents from between 2000 and 2011, and for an easy understanding and a quick analytical view, the results are discussed in detail using various graphs and landscape bubble charts.

1. Introduction

The Intellectual Property Rights (IPR) have become a significant component, which not only protect the invention but also serves as important output indicators of Research and Development (R&D) [1–4]. Intellectual property (IP) in India has taken a pivotal role in making the R&D policy, technology development, business management and forecasting S&T information policy [5–7]. In India IP consists of industrial property such as patents, trademarks, designs and geographical indications along with copyright and sui-generis class including layout design for integrated circuits, protecting plant varieties and trade secrets. Of the various forms of IP, patents remained centre stage since generation due to the major quantitative contribution and international debates, thereby becoming a backbone for developing various industrial sectors [8,9].

Patent documents are not only valuable resources for providing unique technical information and state of art technology, but also grants an exclusive right to the assignee for a certain period of time in specific relevant technology [10–12]. A patent document contains mainly two type of information, firstly bibliometric information, and secondly technological disclosure about the invention. Together, these two indicators provide immense amounts of information related to a specific technology for the assessment, forecasting and management of various fields of technologies [13,14]. Since 2000 the patent activities in India have shown an exponential increase both with respect to filing and granting at the global level. The Organisation for Economic Cooperation and Development (OECD) report has indicated a 40 percent increase in patent filing in US, Europe, Japan and other countries during the year 1992–2002 [15]. Even in India, the same type of scenario continued as total patents filed in year 1995 were 7036 which has been increased to 24,505 by year 2006 contributing 248.28% increase [16]. Further, as indicated by Indian Patent Office (IPO) annual report of year 2011–12, a total of 43,197 patent applications were filed contributing 513.94% increase, indicating the importance and growth of patent documents globally [17].

Although, India has various organisations promoting the scientific and technological activities such as Department of Science and Technology (DST), Department of Biotechnology (DBT) and Indian Institutes of Technology (IITs) etc. CSIR was selected for this study as being the leading public funded organisation with more than 37 laboratories and field stations extended across the country. Rajeshwari has examined the patent statistics of India and Subbaram explained the importance of intellectual property systems [18,19]. The information reported was of late 20th century and not specific towards patent statistical analysis of CSIR [20]. According to the literature survey only limited information is available for recent CSIR patenting & Patent Cooperation Treaty (PCT) filing trends,

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landscape studies and licensing activities altogether. So, the objective of this article is to address these issues using bibliometric study method to identify and analyse the R&D output through comprehensive patent statistical analysis and geographical indication studies. The paper has reported the CSIR national and international patent filing and granting trends from year 2000–2011 and analyses various geographical landscape which not only highlights the past, present and future trends but also reflects the state of R&D invention of the country.

2. Importance of CSIR in India

The Council for Scientific & Industrial Research (CSIR) is the premier public funded agency conducting Research and Development (R&D) in India. Established in year 1942, CSIR has over 37 Laboratory R&D units spread across various fields of specialization such as Biological, Physical, Chemicals, Pharmaceuticals, Drugs, Aerospace, Construction, Minerals, Metals, Earth Resources, Food, Environment, Leather, Information Sciences etc. [21,22]. All these institutes are located one each in major cities/state of India, which are clustered into five broad categories namely Biological, Chemical, Physical, Engineering and Information Sciences. CSIR not only managed to be a top Indian patentee, but also maintained consistently at first position in patents application filed from Scientific and Research & Development [17,23]. CSIR works with the mission to maximise the environmental, social and economic benefit for the people of India. In recent years, it has reoriented its mission towards encouraging innovation-driven industry and nurture transdisciplinary leadership entrepreneurship to generate resources from external clients by IP commercializing and conducting collaborative research. In short, CSIR plays a pivotal role in building the country's largest S&T human resource through various grants, awards and fellowships for the post graduates, PhD's in engineering and sciences.

3. Methodology & data

Bibliometric methodology was followed to study the changes in the R&D pattern and trends. CSIR has the largest patent portfolio among public funded research institutions in India and the data was collected from CSIR patent portfolio report published online on official website [24–30]. The data for geographical landscape analysis includes a total of 4618 patent documents which are In-force in various countries including India. Further, the data for the trend analysis such as number of patents filed and granted were retrieved from CSIR annual reports from the year 2000–2011 published by information centre Head Quarters [31–33]. The Patent Cooperation Treaty (PCT) Filing data was collected from World Intellectual Property Organization (WIPO) patent Statistics on the PCT System and presentations of R.K. Gupta, Management Head of Intellectual Property Management Division (IPMD) in CSIR Laboratories [34–38]. The data related to the licensing activities in CSIR was collected from a Right to Information (RTI) filed by Mr. Prashant Reddy, who requested the details of "the revenues/profits earned by CSIR through licensing of its patents in India and other countries, for the last ten years" [39–42]. All this data includes the bibliometric information such as publication number, title of the invention, date of filing & granted, name of the licensees and various country names.

4. Intellectual property analysis

CSIR has always been at the forefront of Intellectual Property generated in India because of the best facilitated labs and scientists in various field station across the nation. CSIR stands first with respect to the highest number of patent granted and filed when compared to all other public funded research organizations. CSIR is also India's largest research and development body, with more than 4618 patents In-force as of August, 2013 out of which there are 2910 foreign and 1708 Indian patents, contributing to 63 and 37 percent, respectively (Table 1). A single patent can be counted more than once, depending on the number of countries where it is granted. CSIR patent portfolio covers patents in the areas of engineering, physical, biological, chemical, environment, earth and information sciences.

4.1. Geographical distribution analysis

Geographical Distribution is the study of the patent rights covering various areas according to the continent and county wise distribution. As per the given data in Table 1 it is clear that CSIR has more patents filled and granted in foreign countries as compared to India. CSIR has a total of 2910 patents contributing 63% of total active In-force patents in foreign countries. CSIR's number of active patents in other jurisdictions is as follows: U.S stands first in position with a total of 757 patents followed by United Kingdom 258 and Germany 217. France stands at fourth position with 199 patents proceeded by China and Japan with 181 patents each contributing 4% each. Finally, Australia recorded 132 active patents followed by 92 other countries contributing a sum of 21 percent. Table 1 shows the pie chart of geographical distribution of various countries and their percentage contribution, respectively. The geographical analysis reveals that CSIR has more active patents in foreign countries than India and US stands top covering 16% of total 2910 active foreign patents as of August, 2013.

4.2. Patent trend analysis

Patent trend analysis is a statistical or bibilometric method of analysing stages of growth and up's and down's, so as to identify pattern in the information [43,44]. The trend analysis would help in analysing the past, present pattern and forecast future predictions for decision making [45,46]. Trend analysis is not only scrutiny for validation because of its verifiable data but also help identify the failure analysis and problem indicators [47,48]. This article discusses three types of patent trend analysis from year 2000–2011, i.e. National, International patent filing and granting trend along with the number of active patents which are in In-force in India and abroad.

4.2.1. International filing and granting trend

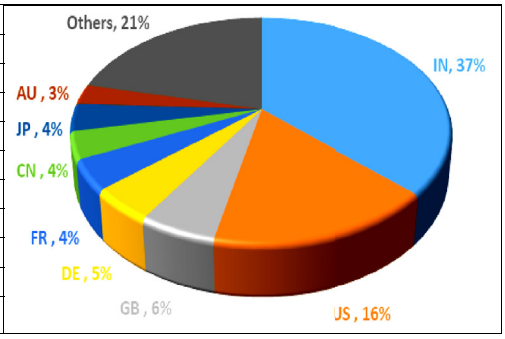
Table 2a shows the values of number of international patents filed and granted by CSIR from the year 2000–2011. It also show a trend analysis illustrated in the form of line graph. As per the graphs, it is clear that CSIR has shown a fluctuating down fall of number of patents filed, whereas the grating trend seems progressively increased over a period of ten years. CSIR has its highest international filed in the year 2002–03 and 2006–07 and least in the year 2009–10. The period 2006–2010 can be considered as era of downfall in international filing, as CSIR was more concerned towards the commercialization of technologies and licensing. Coming to the granting trends, CSIR managed to show an exponential increase from period 2000 to 2005 and thereafter maintained a stagnate growth till 2011. The highest number of patent were granted in the year 2011 and least was in year 2000 with a remarkable fall in between the year 2005–06. Overall the international filing trend seems to decrease and the granting trend showed vice versa over this period of ten years.

4.2.2. National filing and granting trend

The given data in Table 2b indicates CSIR national filing and granting trends along with the number of patent counts from year

Table 1
Geographical Distribution of total CSIR patents In-force.

	Country	Count
National: India (IN)		1708
International	United States of America (US)	757
	United Kingdom (GB)	258
	Germany (DE)	217
	France (FR)	199
	China (CN)	181
	Japan (JP)	181
	Australia (AU)	132
	Others (Appendix-A)	985
	Total	4618



2000–11. CSIR national trend has maintained the same pattern as that of international by showing declining filing trend and wavering improved in granting trend. The national filing was constant from the year 2000–2005 reporting a sudden decrease in year 2006 and thereafter showing a constant filing till year 2011. Whereas, the granting trends seemed to fluctuate a lot but overall showed a progress with its peak in the year 2008–09. In both the cases one can clearly observe the drastic downfall of both filing and granting rates in the year 2006–07.

In conclusion, there was a sharp decrease in the filing procedure in the year 2006–08 for both national and international filing and the reason was deduced by a CSIR official as a "*deliberate intervention to focus on commercially and strategically important inventions*" [37]. The same was reflected in the graphs of PCT filing (Table 3) and licensing trend (Table 4) showing the maximum patents licensed out in the next year. The comparative studies of the international filing reveal that the total number of patents granted were far less than the number of applications filed. Whereas, in the case of national level, the filing seems to be plateau although high as compare to that of wavering patent granted till 2005–06, thereafter a sharp increase in the number of granted patents, which reached to its maximum of 703 patents in the year 2008–2009.

4.2.3. Patent In-force trend

Table 2c provides the information related to CSIR number of patents In-force at both national and international level from year 2000–11. A combo graph was showed with bar graph representing the number of active patents in India and line graph representing the active patents abroad. As depicted by the data, it is clear that the number of national patent In-force were dominating over international from period 2000 to 2006. Whereas, the number of international patents In-force were predominated from the year 2006 till today. In both the cases the trends seem to maintain a progressive increase with no significant downfall. The year 2009–10 was the peak year for both national and international to maintain the maximum number of patent In-force i.e. 2349 and 3054, respectively and the year 2000–01 has marked the least with 657 and 249, respectively. The year 2006–07 has marked a milestone when the CSIR has succeeded in capturing the global market by showing more number of foreign patents as compared to that of India. In summary, the future forecast is that the number of patent In-force would increase every year gradually but international patent would dominate the national patents.

4.3. Patent Cooperation Treaty (PCT) filing trend

Patent Cooperation Treaty (PCT) is a unified procedure for filing patent applications in more than 148 countries throughout the world. CSIR was the leading public funded research organisation to file the maximum number of PCT applications from the developing countries. Table 3 shows the ten years of CSIR PCT filing data from year 2002–2012 and compared with the total number of PCT applications filed by Indian Receiving Office (RO) under the category of middle-income origins by region. A combo graph was plotted taking year on *X*-axis and number of PCT application count along with the percentage contribution on *Y*-axis. The PCT application count was indicated by bar graph and percentage contribution was showed as line graph. As per the graph, CSIR has showed a progressive increase in number of PCT application filed and reaching its maximum in year 2004–05 and thereafter a sudden downfall was recorded till date reporting its least in year 2010–11. Indian receiving office has recorded the maximum PCT applications in year 2010–11 and least in 2004–05.

Analysing the percentage distribution of total CSIR PCT application with total PCT from Indian RO, CSIR contributed more than 10 percent from the year 2003–2007 which can be considered as booming period for PCT filing. But, after 2005 the same scenario of downfall of applications was reported as that of CSIR International and National Patent filing and granting trends indicating the same reason of deliberate intervention to focus on commercially and strategically important inventions.

4.4. Patent Licensing Pattern & Revenue analysis

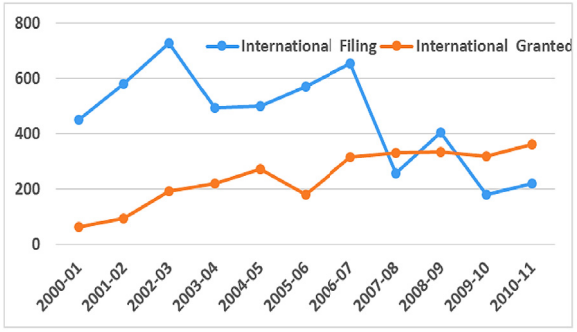
For long, CSIR maintained silence in revealing the licensing or financial expenditure details regarding their Intellectual property rights. A recent event was the filing of a Right to Information (RTI) by Mr. Prashant Reddy, who requested information on the recent ten years of licensing and revenue details of CSIR in India and abroad [39]. After appeals and reminders for six months, CSIR has provided a comprehensive report of the licensed patents. CSIR responded to the RTI by disclosing the information from March 2002 to March 2012, that it has spent $ 742.4 Million (Rs. 74.24 crores) on securing patents for the inventions in both India and abroad. Of this $742 Million only $17.8 Million (1.78 crores) were spent to secure the Indian patents and remaining was utilized for international PCT filing and protecting the inventions in various countries like US, Europe, China, Japan etc. Earlier, in year 2008, V.C. Vivekanandan has also reported a few financial details of IP Protection of public funded research in India, where CSIR and DBT financial details were compared and correlated with licensing [49].

After careful observation of the RTI response, a year wise licensing pattern was plotted in Table 4. As per the records from March 2002 to 2012, CSIR has licensed out promising record of 454 patents, of which the number of Indian patents licensed were more when compared to the International patents. However, if the number of licensed patent are compared with number of In-force patents, more than 5000 active patents were reported as of 2011,

Table 2
Details of CSIR patents filed and granted from 2000 to 2011.

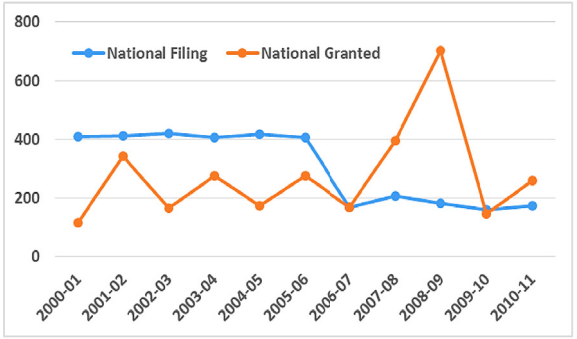
Year	International	
	Filing	Granted
2000-01	452	62
2001-02	580	94
2002-03	728	191
2003-04	495	218
2004-05	500	272
2005-06	570	179
2006-07	655	316
2007-08	256	331
2008-09	404	333
2009-10	179	319
2010-11	220	361

a) CSIR International Patents Filed and Granted



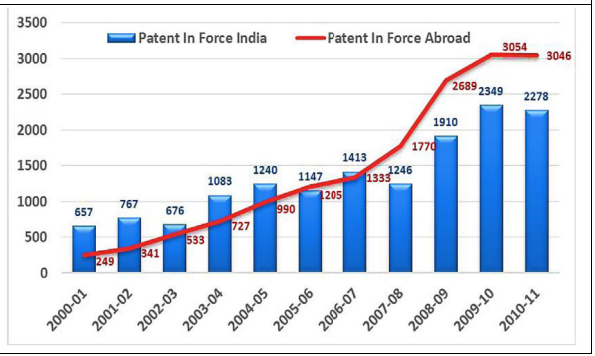
Year	National	
	Filing	Granted
2000-01	409	117
2001-02	413	342
2002-03	421	166
2003-04	406	275
2004-05	418	175
2005-06	407	276
2006-07	169	169
2007-08	207	395
2008-09	183	703
2009-10	161	145
2010-11	174	260

b) CSIR National Patents Filed and Granted



Year	Patent In Force	
	India	Abroad
2000-01	657	249
2001-02	767	341
2002-03	676	533
2003-04	1083	727
2004-05	1240	990
2005-06	1147	1205
2006-07	1413	1333
2007-08	1246	1770
2008-09	1910	2689
2009-10	2349	3054
2010-11	2278	3046

c) CSIR Patents In-Force

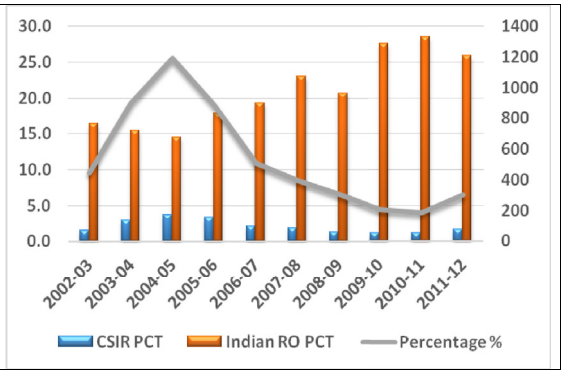


the percentile licensed out would only account for 10 percent and the revenue generated through licensing is obscure. As per the Chart shown in Table 4, the line graph represents CSIR number of patents licensed out versus year of licensing and a fluctuating pattern was observed. The line graph illustrates the uniform growth of licensing from year 2000–2005 and thereafter a slight decline till 2006 and a sharp downfall of licensing was noted in the year 2007. Nonetheless, the licensing pattern has shown a sudden increase the next year because of deliberate intervention of officials to focus more on commercialization, as a result the year 2008–09 has recorded the maximum number of patents to be licensed. Although, the decreasing pattern was observed from 2009 to 2011 one has to understand that licensing is a dynamic process and commercialization is ongoing activity which needs a regular surveillances time to time. A point to be noted is that, out of 454 patents licensed out, each patent can be counted more than one time as there are cases of same patent getting licensed to multiple parties such as “Virgin Coconut Oil” [39].

CSIR has licensed out diverse technologies such as mining, water filtration, construction, medical, pharmaceutical, chemical and food technology etc. Furthermore, the licensee were also diverse ranging from Multinational Companies to small SMEs from various countries such as India, U.S, Italy and Malaysia etc. The list of companies include Emcure Pharmaceuticals, Ranbaxy, Nicholas Piramal, Cadila Pharmaceuticals, Nostrum Pharmaceuticals, Shreya Life Sciences, General Electric, Defence Research and Development Organisation (DRDO), Pepsi, Cocoa-Cola, Mines & Minerals Ltd., Tata Chemicals, and National Mineral Development Corporation (NMDC) etc. Apart from the mentioned, even patents were licensed to small companies and even individuals. Finally one can disclose that CSIR has showed a promising number of patents licensed out, indicating a strong active licensing network. However, it would be of additional interest to obtain and study the undisclosed information, thereby understanding the mechanism of outsourcing or work flow pattern followed by CSIR to license its technologies.

Table 3
Details of CSIR Patent Cooperation Treaty (PCT) filing trend from 2002 to 12.

Year	CSIR PCT	Indian RO PCT	%
2002-03	73	764	9.6
2003-04	139	724	19.2
2004-05	173	679	25.5
2005-06	158	831	19.0
2006-07	98	901	10.9
2007-08	91	1072	8.5
2008-09	63	961	6.6
2009-10	56	1286	4.4
2010-11	53	1330	4.0
2011-12	77	1208	6.4



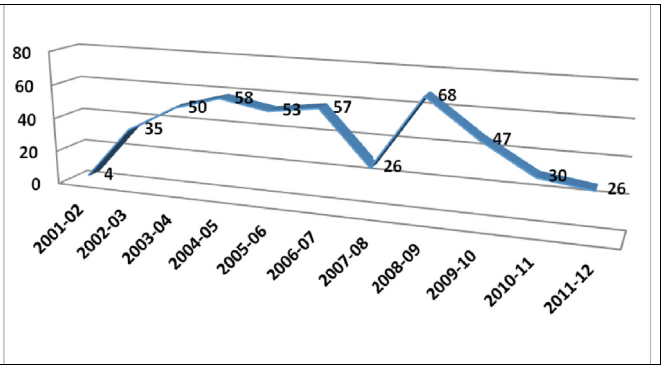
4.5. Geographical Landscape analysis

Patent Landscape analysis would give an aerial view of the specific situation with their chronological changes in a given region and country on the global level. A geographical landscape analysis was also performed on 2910 international patent documents which are In-force by considering three attribute i.e. granted year, country name and number of active patents. Figure 1 shows the landscape view of all the international patents in form of bubble chart, more the patent count greater the size of bubble and vice a versa (the bubble density was set to 45). The bubble chart clearly depicts the chronological order of year on *Y*-axis from 1997 to 2013 and simultaneously rank and mention the top 30 countries on *X*-axis. As per the details shown, top 10 countries are occupied by United State of America, United Kingdom, Germany, France, China, Japan, Australia, South Africa, Canada and Italy with 757, 258, 217, 199, 181, 181, 134, 91, 85 and 67 number of total active patents, respectively. The individual year wise distribution can also be seen through bubble size with specific colour variations for each country. CSIR has 4618 active patents and India holds the maximum number of patents followed by US, United Kingdom and others. Considering the US patent trend, year 2004 and 2006 have reported the maximum number of active patents, whereas the least was recorded in the year1997. The top 15 countries has shown a consistent growth of patent numbers throughout the period of 2002–12, except Canada which showed a gap in the year 2007 and 2005.

Except Bangladesh (BD) the year 2012 has recorded a minimum of one patent each in all mentioned 30 countries, with US and Japan standing at first and second positions with 37 and 28 patents, respectively. On the contrary Bangladesh also reported a good patent activities before 2005, but thereafter CSIR has minimized the filing in Bangladesh. Furthermore, Bangladesh (BD) and Kenya (KE) are the only two underdeveloped countries that managed to be in top 30, along with the developed and developing countries according to Human Development Index (HDI) [50]. The white space in the bubble graph indicate the inactive period where no patents were In-force, for example if we consider the patenting activity of last 10 countries i.e. Sweden (SE) (20th position) till Kenya (KE) (30th position), except 2 patents from Vietnam none has report any active patents from year 1997–2003. The bubble chart shown in Fig. 1 not only shows the year wise patent distribution of various countries but can also provide information if cross tabulated and analysed from different angles. Altogether CSIR has covered a total of 92 countries to protect their inventions in various continents, the list of all the countries with their code is made available in Appendix A.

Table 4
CSIR Patent Licensing patterns.

Year	CSIR License
2001-02	4
2002-03	35
2003-04	50
2004-05	58
2005-06	53
2006-07	57
2007-08	26
2008-09	68
2009-10	47
2010-11	30
2011-12	26



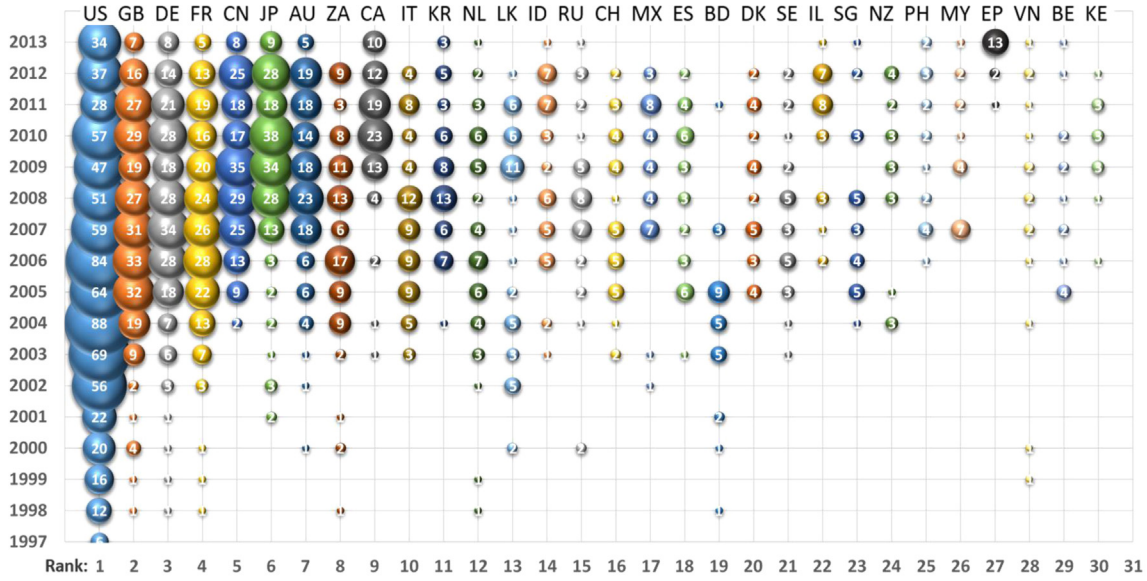


Fig. 1. Year and Country wise geographical landscape analysis of CSIR patents In-force.

5. Conclusion

The paper has discussed extensive Intellectual Property details of CSIR for a period of ten years. It is a full data compilation of patent filing and granted along with the number of active patent In-force, PCT filing, licensing patterns, revenue details and geographical analysis. which otherwise are not available in this form. The paper also addressed the various trends and discussed the reasons of downfalls and identified milestones alone with pictorial representations. The geographical landscape bubble chart is first of its kind to report the year and country wise patenting activities of CSIR in various countries. In conclusion, CSIR not only acquired the highest Intellectual Property of India, but also has maintained India's top position as one among the top ten public funded research organisations in Asia. The inference is that, CSIR patenting trend can be categorised into two eras, one prior to 2005 where CSIR showed more interest in protecting their inventions through filing more patent applications in India than abroad. Whereas after 2005, CSIR has changed the scenario of publishing patents and focused more on strategically novel invention and commercializing the same by encouraging transdisciplinary leadership/entrepreneurship. The reason behind the changes can be deduced as the implementation of Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement in India as on 1st January 2005 which encouraged globalization. This era is considered as a period where in CSIR has emerged as a potential global competitor by capturing more of the international market thereby maintaining more foreign patents In-force. In any case CSIR has always been at the forefront of Intellectual Property generation in India and may be considered as a pioneer amongst public funded research organisation nationally and internationally.

Acknowledgements

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Appendix A

AM	Armenia
AP	ARIPO
AR	Argentina
AT	Austria
AU	Australia
AZ	Azerbaijan
BD	Bangladesh
BE	Belgium
BG	Bulgaria
BR	Brazil
BY	Belarus
CA	Canada
CH	Switzerland
CN	China
CO	Colombia
CR	Costa Rica
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
DZ	Algeria
EA	Eurasian Patent
EE	Estonia
EG	Egypt
EP	Europe
ES	Spain
FI	Finland
FR	France
GB	United Kingdom
GE	Georgia
GR	Greece
HK	Hong Kong
HR	Croatia
HU	Hungary
ID	Indonesia
IE	Ireland
IL	Israel
IR	Iran
IS	Iceland
IT	Italy
JO	Jordan
JP	Japan
KE	Kenya
KG	Kyrgyzstan
KP	Democratic Korea

(*continued on next page*)

(*continued*)

KR	Republic Korea
KZ	Kazakhstan
LB	Lebanon
LI	Liechtenstein
LK	Sri Lanka
LT	Lithuania
LU	Luxembourg
LV	Latvia
MA	Morocco
MC	Monaco
MD	Republic Moldova
MG	Madagascar
MN	Mongolia
MW	Malawi
MX	Mexico
MY	Malaysia
MZ	Mozambique
NG	Nigeria
NI	Nicaragua
NL	Netherlands
NO	Norway
NZ	New Zealand
OA	OAPAI Patent
PE	Peru
PH	Philippines
PK	Pakistan
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
TJ	Tajikistan
TM	Turkmenistan
TR	Turkey
TT	Trinidad & Tobago
TW	Taiwan
TZ	Tanzania
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan
VN	Viet Nam
ZA	South Africa
ZM	Zambia
ZW	Zimbabwe

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