

Assessing grey literature use by researchers of Council for Scientific and Industrial Research (CSIR), India

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The present study on the use of both external and internal grey literature by CSIR researchers shows that technical reports are most used followed by doctoral theses. It was found that engineering and physical sciences laboratories use more internal grey literature than chemical and biological sciences laboratories. These and other findings help in framing content development policy for technical grey literature, framing policies for internal grey literature archiving, designing digital repository framework to archive internally generated grey literature and improve access and devise ways to enhance their visibility and use.

Keywords: Grey literature; CSIR; Theses; Dissertations

Introduction

Reviewing the literature helps researchers to assess current status, identify gaps, formulate methods and evolve other measures to further their own research. Extensive exposure to the literature helps in expanding horizons of an area and also develop critical thinking in a researcher¹. The emergence of information and communication technologies, the internet and e-publishing have revolutionised access to literature. The digital shift in information creation, processing, delivery, and dissemination has empowered researchers in getting quicker and easier access to information. The technological developments also facilitate an increase in scholarly publishing with researchers using new publishing platforms to communicate their research findings.

The use of raw research data broadly termed as 'grey literature' is also increasing along with peer-reviewed literature that is generally known as 'white literature.' The quantum of such raw research data is also increasing on digital platforms². It is reported that in the current technology-driven publishing ecosystem, grey literature has become an indispensable resource for researchers in all disciplines³. The dedicated repositories of grey literature, open access institutional repositories, subject repositories, author homepages, and blogs etc., are playing a significant role in disseminating grey literature.

In this study, we explore the usage of grey literature in CSIR laboratories in India.

Review of literature

A considerable amount of research findings fails to make into conventional publishing channels and remain as unpublished literature in the grey form. Earlier, grey literature was considered as fugitive literature since it was difficult to locate and retrieve them owing to the absence of indexing sources. Today, the digital ecosystem and e-publishing platforms have enhanced accessibility to grey literature⁴. The public web, preprint servers, open access institutional repositories, digital grey literature systems, etc., have made it easy to access grey literature not only freely but also without time lags⁵. Web information discovery tools such as Google Scholar, Microsoft Academic Search, BASE-academic search engine etc., have enlarged discoverability of grey literature on the web⁶. The increase of grey literature on the web has been attributed to the production of grey literature in digital format, digitization of print content and retrospective activities leading to republication⁷.

The genesis of grey literature can be traced back to early nineteenth century in the form of report literature in the aerospace domain⁸. These reports that were of classified nature were available in a restricted environment. The scientific and technological

developments during World War II lead to a multifold increase in grey literature. Attempts were made from time to time to categorize the grey literature document types based on the nature of the information they carried^{8,9,10}. Adams et al. (2017) categorized grey literature in the three different tiers based on retrievability and credibility criteria. The tier one category comprises of document types such as theses, reports, dissertations, datasets, think tank publications and so on, tier two category consists of annual reports, newsletters, company publications so on, and tier three document types are blogs, emails, tweets, letters so on¹¹. Open access (OA) institutional and subject repositories are new platforms for scientific communication, be it white or grey literature. Repositories are successful in giving wider visibility and accessibility to content archived through various harvesters and aggregators, and with their own retrieval mechanisms¹².

Citation databases available in open access domain such as Google Scholar, Citeseer and so on are tracking citations for grey literature archived at various websites and preprint repositories¹³. There are a very few citation studies that have assessed the use of grey literature. One study on the use of grey literature used in veterinary medical journals revealed the usage is minimal in the medical and veterinary field as compared to aerospace and agriculture¹⁴. Another study on select historical journals to know the degree of grey literature usage showed the greater use of grey literature¹⁵.

There is a need for more studies on grey literature use by researchers to help further understand the dynamics of citation behavior in the digital era. This will enhance libraries and documentation centers to establish a framework to capture and archive technical grey literature for the benefit of users. The present study is an attempt towards that.

Council for Scientific and Industrial Research (CSIR), India

The Council of Scientific and Industrial Research (CSIR) is a premier Indian research and development organization carrying research in diverse areas of science and technologies. Its thirty-nine national laboratories (Table 1) are spread across India. On average CSIR files, about 200 Indian patents and 250 foreign patents per year with 13.86% of CSIR patents being licensed which is above the global average. CSIR is one of the top-ranked research institutes among global institutes according to Scimago ranking world report. The constituent laboratories of CSIR are grouped into five clusters based on the research domain namely; physical sciences, engineering sciences, chemical sciences, biological sciences and information science. CSIR contributes about 10% of Indian scientific output published in SCI journals. CSIR also generates a significant amount of grey literature.

The study is limited to grey literature use pattern of four CSIR cluster laboratories namely, chemical sciences, physical sciences, biological sciences, and engineering sciences. The information sciences cluster of CSIR has not been included in the study as the institutes in this cluster are not actively engaged in scientific research.

Objective of the study

- To assess the use of technical grey literature by CSIR researchers.

Methodology

In November 2018, using the affiliation search feature of SCOPUS, publications data for the period of 1993-2017 for each CSIR laboratory was retrieved. The 'source' information extracted from each cited references was analysed through specifically designed PHP module with the data stored in the MySQL

Table1 — Clusters of CSIR laboratories

<i>Engineering</i>	<i>Physical</i>	<i>Biological</i>	<i>Chemical</i>	<i>Information</i>
CSIR-NAL	CSIR-NPL	CSIR-NBRI	CSIR-CLRI	CSIR-NISCAIR
CSIR-AMPRI	CSIR-NIO	CSIR-IITR	CSIR-CECRI	CSIR-NISTADS
CSIR-SERC	CSIR-NGRI	CSIR-IMT	CSIR-NIIST	CSIR-URDIP
CSIR-NML	CSIR-CSIO	CSIR-IIIM	CSIR-NEIST	CSIR-4PI
CSIR-NEERI	CSIR-CEERI	CSIR-IICB	CSIR-NCL	
CSIR-IMMT		CSIR-IHBT	CSIR-IIP	
CSIR-CRRI		CSIR-IGIB	CSIR-IICT	
CSIR-CMERI		CSIR-CIMAP	CSIR-CIMFR	
CSIR-CGCRI		CSIR-CFTRI	CSIR-CSMCRI	
CSIR-CBRI		CSIR-CCMB		
		CSIR-CDRI		

database. The count of tier one technical grey literature sources based on categories proposed by Adam's, like technical report, technical memorandum, technical notes, theses, dissertations, project reports, project documents, lecture notes, and so on were noted by framing query for pattern matching and extraction technique from the MySQL database. The retrieved cited technical grey references were reviewed manually. Technical memoranda, technical notes, and project documents have been included in the category of technical reports. The references were further divided into internal and external grey for the selected sample laboratories from each cluster. Internal grey literature was identified by the laboratory name or abbreviation associated with the internal grey cited reference. For example: Mukund, R., Graphical evaluation of the threshold in calculating the intermittency from hot-film signals (2011) *NAL PD EA 1113*, CSIR NAL, Bangalore, India;) where NAL (is laboratory abbreviation for National Aerospace Laboratories), PD is document type for Project Document, and EA is division name of Engineering Aerodynamics. The count of extracted cited references and publication details of each laboratory were tabulated using Microsoft Excel for analysis.

Results

Previous studies have shown that the use of grey literature, especially technical grey literature that includes raw data, is more in applied science than pure science. Figure 1 shows that that engineering and physical science cluster laboratories cited more grey literature as compared to biological and chemical science researchers.

The grey literature use behavior of CSIR researchers by laboratory wise is reflected in Figure 2. High use of grey literature is seen among engineering cluster laboratories followed by physical sciences cluster. CSIR-CRRI referred highest grey literature in its publications with 4.08 average followed by CSIR-SERC with 3.07 averages. The use of grey literature among biological and chemical researchers are low as compared to other two clusters. Interestingly CSIR-CIMFR that is involved in research activities of mining and fuel research referred to a relatively high sources of grey literature with an average of 3.02.

The chemical laboratory CSIR-IICT published highest publications during the period used the lowest average of 0.15 of grey literature. It is observed that the top 200 citing papers from all laboratories used grey literature. The grey literature use in top 200 citing documents is less than the overall average

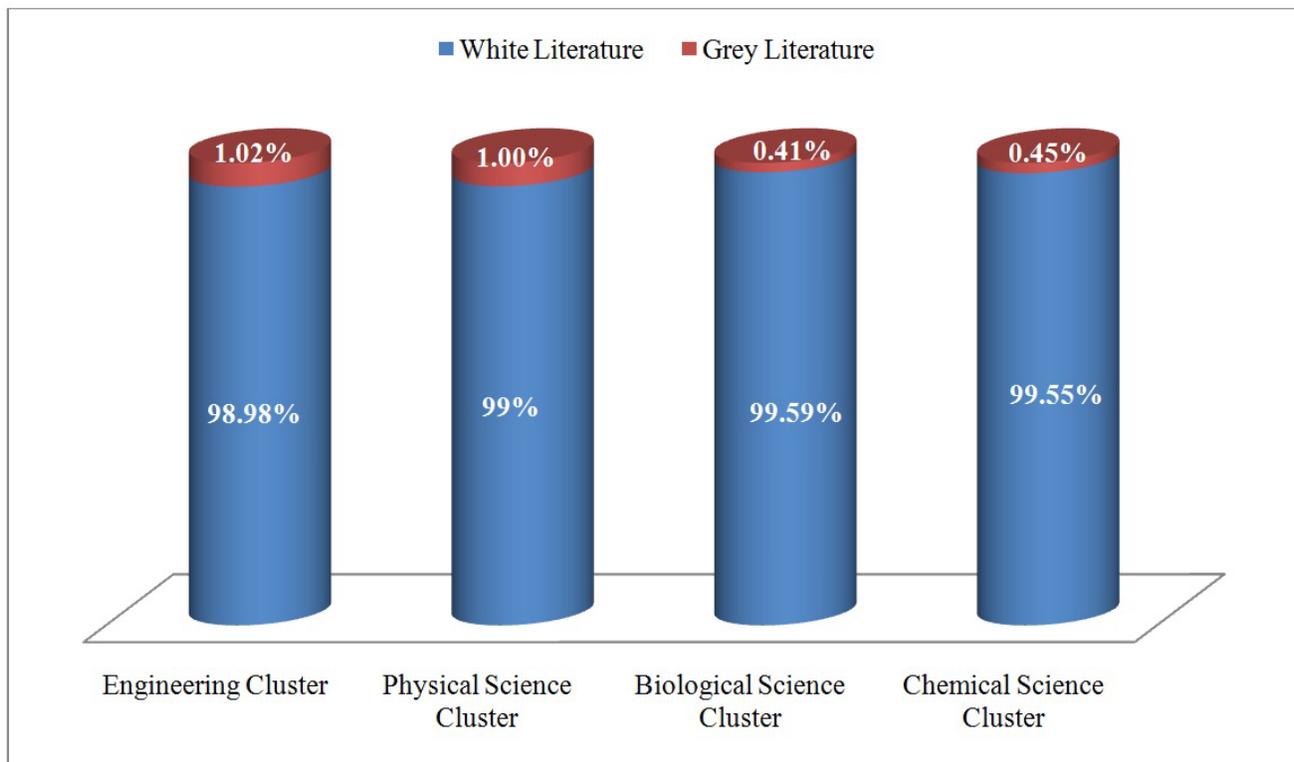


Fig. 1 — Grey literature percentage of overall publications

except in two laboratories, namely CSIR-CDRI and CSIR-CSMCRI from biological and chemical sciences cluster respectively. The majority of the laboratories used the same amount of grey literature in top citing articles, however relatively higher difference is seen among an overall average of engineering and physical sciences cluster laboratories.

Researchers consult a wide range of information resources in their research process. The advent of internet technologies has given rise to large number of grey literature sources which can be accessed quickly and easily. Figure 3 gives a cross-section of grey literature use by CSIR researchers. It is evident from below figure that CSIR cited references comprised four

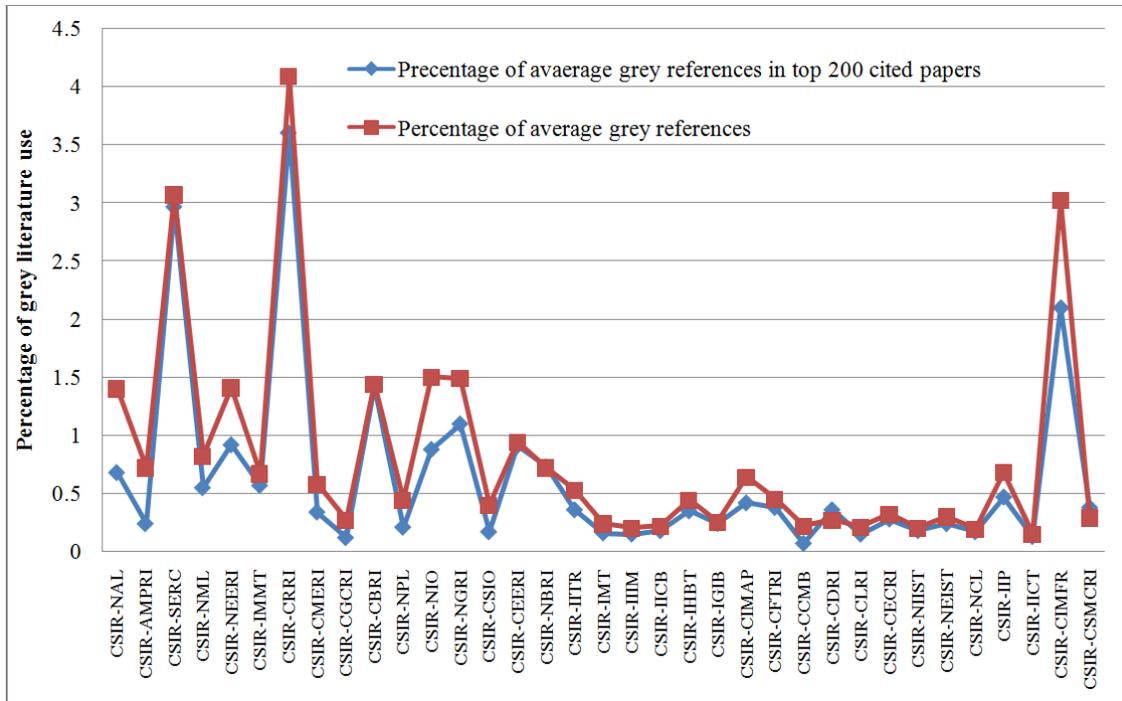


Fig. 2 — Grey literature percentage of overall publications and top 200 CSIR citing papers

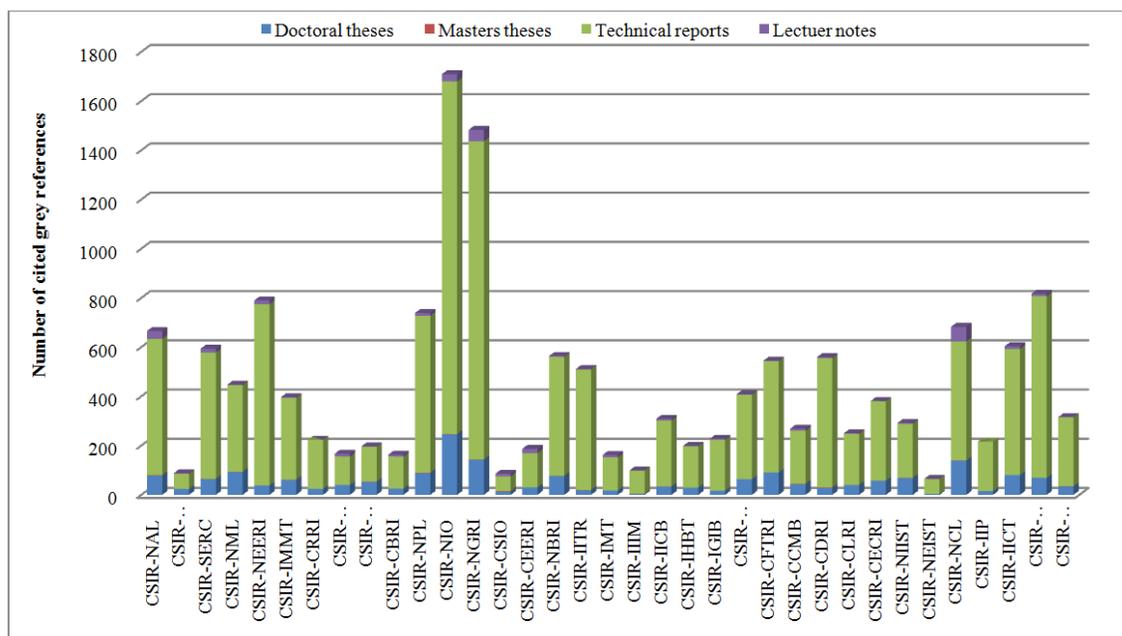


Fig. 3 — Average cited tier one grey references document types

major grey document types, namely doctoral theses, masters theses, technical reports, and lecture notes. Technical reports are the primary type of grey literature used across all four clusters laboratories. CSIR-NIO and CSIR-NGRI cited the highest number of technical reports in their publications. The use of technical reports among engineering laboratories is relatively more. The second major grey literature document type referred by CSIR researcher community is doctoral thesis followed by lecture notes.

Internal /External grey literature use among CSIR laboratories

It is a well-established fact that the process of research generates a lot of new data at each research laboratories, and little of this gets published in the form of scholarly publications. The unpublished data remains with the laboratory as grey literature and fails to reach the outside world.

Figure 4 shows the use percentage of internal and external grey literature of selected laboratories from each cluster. The internal grey literature use is more in CSIR-NAL, an engineering cluster laboratory with 19.5% followed by physical science laboratory, CSIR-NIO (11.7%). Interestingly, CSIR-NAL and CSIR-NIO are the first laboratories to establish open access repositories to archive their publications including large number of grey literature. Possibly the

ease of accessibility resulted in high usage. Biological and chemical sciences laboratories showed minimal use of internal grey literature.

Discussion

Since independence, India witnessed rapid development in research and development by establishing several chain of research organizations such as ICMR (Indian council for medical research), ICAR (Indian Council for Agriculture Research), DRDO (Defence Research and Development Organization), ISRO (Indian Space Research and Organization), DBT (Department of Bio-Technology), DST (Department of Science and Technology), CSIR so on. India stands ninth position in contributing to global science and technology as per SCIMAGO 2019 country ranking. CSIR contributes about 14% of Indian scientific publication output¹⁶. The data reveals that the contributions from chemical and biological sciences are large and on par with international trends established by several studies^{17,18,19,20}.

Grey literature, especially technical grey literature is evolving as one of the important information sources for researchers. The use of citable grey literature is increasing day by day with the availability of various discovery tools such as search engines, subject and institutional repertories, grey literature

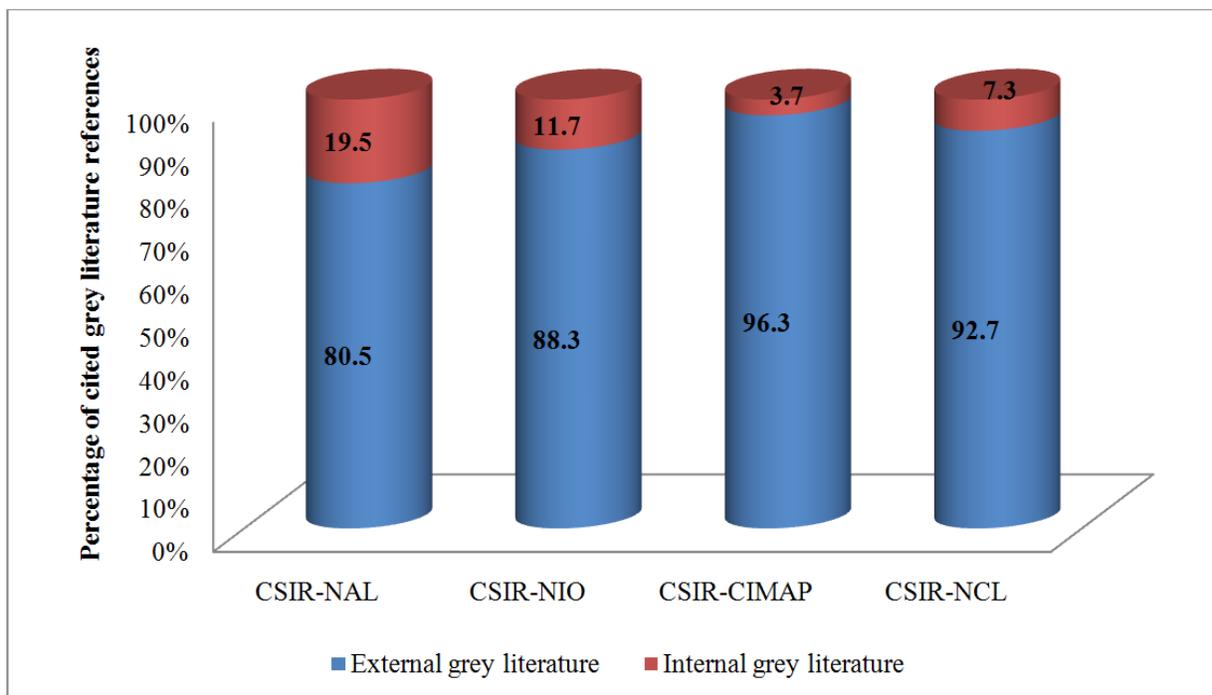


Fig. 4 — Percentage of external vs internal cited grey literature of one selected CSIR laboratory from each cluster

repositories, so on. Though grey literature not considered as a popular source of citation study, several attempts were made to evaluate the extent it contributes to scientific research^{21,22,23}. Open access institutional repositories had opened a new channel of publishing the grey literature and making them from invisible to visible content.

CSIR with its open access policies mandated all to establish institutional repositories at each laboratory to archive all its publications. However, major content type at CSIR repositories remained reviewed content in the form of journal post print and preprints, conference papers and book chapters. Among grey literature document types at CSIR repositories doctoral and masters' theses are the major content type archived followed by technical reports by few laboratories²⁴.

That the CSIR researchers are using grey literature is evident from the study. The usage of technical reports is more across all laboratories attributed to easy access to these sources through various international grey literature repositories available on the Internet. Doctoral and masters' theses constitute an essential part of academic requirements and contain original research findings of a student. Often these resources are considered academic grey literature²⁵. Doctoral theses, the second largest grey literature type used by all laboratories, CSIR-NIO and CSIR-NCL used maximum theses compared to others. The minimum use of internal grey indicates the lack of archival policies; technology infrastructure; awareness about grey literature; coordination between scientists and knowledge resource centers at laboratory needs to be investigated to address the issues.

Conclusion

The study reported here has identified the publication productivity, the scholarly content and technical grey literature use pattern by CSIR researchers by investigating cited references. Several studies proved that the researcher is often unaware of the grey literature due to the lack of bibliographic control, archiving platforms, accessibility. The shift in publishing technologies and the invasion of digital tools had transformed the grey literature publishing. Open access repositories created new avenues for grey literature to make their presence with easy accessibility and visibility. Though CSIR has adopted open access policies and first to establish open access repositories in most of its laboratories, they confined

to archive reviewed literature rather than grey literature generated at their laboratories. The study shows that CSIR researchers are using both internal and external grey literature, but sparsely. The reason may be lack of grey literature archival policies and framework which needs an investigation. Well defined and customized grey literature archiving framework to cater to the local needs of CSIR laboratories will encourage Knowledge Resource Centers (KRC's) to archive grey literature more efficiently.

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Appendix

Abbreviations of CSIR research laboratories:

CSIR: Council for scientific and Industrial Research
CSIR-NAL: CSIR-National Aerospace Laboratories
CSIR-AMPRI: CSIR-Advanced Materials and Processes Research Institute
CSIR-SERC: CSIR-Structural Engineering Research Centre
CSIR-NML: CSIR-National Metallurgical Laboratory
CSIR-NEERI: CSIR-National Environmental Engineering Research Institute
CSIR-IMMT: CSIR-Institute of Minerals and Materials Technology
CSIR-CRRI: CSIR-Central Road Research Institute
CSIR-CMERI: CSIR-Central Mechanical Engineering Research Institute
CSIR-CGCRI: CSIR-Central Glass Ceramic Research Institute
CSIR-CBRI: CSIR-Central Building Research Institute
CSIR-NPL: CSIR-National Physical Laboratory
CSIR-NIO: CSIR-National Institute of Oceanography
CSIR-NGRI: CSIR-National Geophysical Research Institute
CSIR-CSIO: CSIR-Central Scientific Instruments Organisation
CSIR-CEERI: CSIR-Central Electronics Engineering Research Institute
CSIR-NBRI: CSIR-National Botanical Research Institute
CSIR-IITR: CSIR-Indian Institute of Toxicology Research
CSIR-IMT: CSIR-Institute of Microbial Technology
CSIR-IIIM: CSIR-Indian Institute of Integrative Medicine
CSIR-IICB: CSIR-Indian Institute of Chemical Biology
CSIR-IHBT: CSIR-Institute of Himalayan Bioresource Technology
CSIR-IGIB: CSIR-Institute of Genomics and Integrative Biology
CSIR-CIMAP: CSIR-Central Institute of Medicinal Aromatic Plants
CSIR-CFTRI: CSIR-Central Food Technological Research Institute
CSIR-CCMB: CSIR-Centre for Cellular Molecular Biology
CSIR-CDRI: CSIR-Central Drug Research Institute
CSIR-CLRI: CSIR-Central Leather Research Institute
CSIR-CECRI: CSIR-Central Electrochemical Research Institute
CSIR-NIIST: CSIR-National Institute for Interdisciplinary Science and Technology
CSIR-NEIST: CSIR-North - East Institute of Science and Technology
CSIR-NCL: CSIR-National Chemical Laboratory
CSIR-IIP: CSIR-Indian Institute of Petroleum
CSIR-IICT: CSIR-Indian Institute of Chemical Technology
CSIR-CIMFR: CSIR-Central Institute of Mining and Fuel Research
CSIR-CSMCRI: CSIR-Central Salt Marine Chemicals Research Institute