

Grey literature on climate change studies at the International Nuclear Information System

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Abstract

Established in 1970 by the International Atomic Energy Agency (IAEA), the International Nuclear Information System (INIS) has since served as a major subject repository in all areas related to nuclear science and technology. Despite its name, INIS has also made significant efforts in harvesting, categorizing, and publishing records on subjects of broader interests like energy in general or climate change studies. As a result, more than 4.5 million bibliographic records are now stored and made publicly online by INIS with topics ranging from like general studies of nuclear reactors, instrumentation related to nuclear science and technology, to energy planning, policy, and economy, or environmental science. This paper will present an analysis on the grey literature on climate change-related subjects that have been harvested by INIS, as well as the interest of INIS users on these subjects. For example, 50% of records in the INIS repository mentioning climate change in their abstracts can be considered grey literature, or according to the categorizing system of INIS (the INIS Thesaurus), the repository has 1656 reports on “climate change”, 685 on “greenhouse effect”, and 24 on the Paris Agreement. On the other hand, INIS users have showed their increasing interest in climate change-related subjects via the more prominent appearance of search terms like “climate change” or “climate change and nuclear power”. The analysis results show that INIS has become a useful bibliography bridge for users to connect their interest in topics directly related to nuclear energy, and in studies on climate change. As INIS currently receives about 150,000 unique searches every month with users coming from all over the world, especially from developing countries with lesser access to credible studies on climate change or other energy-related topics, INIS can play an important role in bringing grey literature on climate change closer to the public, and thus support in raising better public awareness on this timely and important topic.

Introduction of INIS

In 1957, the International Atomic Energy Agency (IAEA) was established to “accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world”¹. To carry out this objectives, seven functions of the IAEA have been outlined by its Statute, of which the third and fourth directly focus on the exchange of scientific and technical information on the peaceful use of nuclear energy. These functions of the IAEA are further emphasized in Article VIII of the Statute on exchange of information, namely the Agency “shall take positive steps to encourage the exchange among its members of information relating to the nature and peaceful uses of atomic energy and shall serve as an intermediary among its members for this purpose”. Accordingly, the creation of the International Nuclear Information System (INIS) under the auspice of the IAEA was authorized by its Board of Governors in February 1969, which had its first product – the monthly bulletin “INIS Atomindex” Vol. 1, No. 1 in May 1970.² After decades of exclusivity of usage among INIS Member States, the database of INIS was opened to public on a free, open, and web-based access via its Repository³ in April 2009 and it has been since become one of the largest custodians on the Internet of conventional and non-conventional literature published in the nuclear field.

¹ IAEA, The Statute of the IAEA, url: <https://www.iaea.org/about/statute>

² C. Todeschini, “The International Nuclear Information System (INIS): The First Forty Years 1970-2010”, International Atomic Energy Agency, October 2010.

³ INIS Repository, url: <https://inis.iaea.org/search/>

As of 2023, the INIS Repository hosts more than 4.5 million bibliographic records, about 2 million of which are full-text records with 600,000 full-text PDFs stored by the Repository itself. This significant reserve of nuclear-related literature has been expanded year with more than 100,000 new records thanks to the collaborative effort between INIS, its 132 Member States, and 17 organizations, which pool decentralized inputs from scientific publishers, national and international institutions, or relevant entities into one centralized storage that is the INIS Repository for further processing and public dissemination. The number of inputs to the INIS Repository is provided in Figure 1.

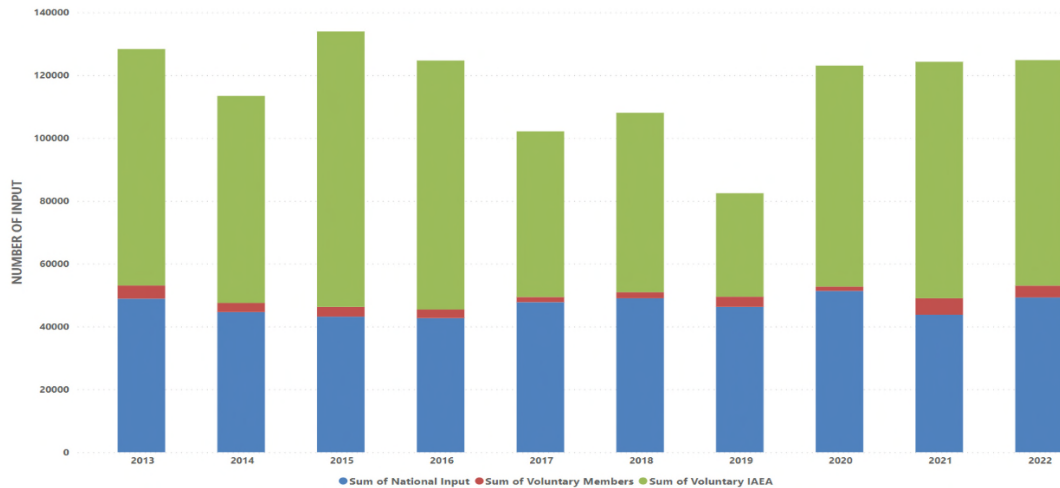


Figure 1. Number of inputs to the INIS Repository, 2013 – 2022.

Climate change, scientific publication, and grey literature

In recent decades, climate change has gradually become one of the most important issues with global impact that receives significant attention not only from the scientific community but also policy makers and the public, especially since the more and more negative effects of climate change could be observed in every country, especially ones with long coastlines and/or close to the Equator. For example, all the countries most affected by extreme weather events in the period between 2000 and 2019 as identified by the Global Climate Risk Index are ones with large maritime interfaces and mostly of developing economic status, namely Puerto Rico, Myanmar, Haiti, the Philippines, Mozambique, the Bahamas, Bangladesh, Pakistan, Thailand, and Vietnam.⁴

Recently, the link between scientific findings and policy making, especially with regards to emerging issues that require a high level of science and technology inputs like climate change, has been emphasized by policy makers, media outlets, and the public in general.⁵ Thus, one might assume that there would be a causal relation between a country's level of exposure to climate change and its interest in climate change studies and consequently its scientific output in climate change research, namely climate change-related peer-reviewed papers or books. However, this is not the case as most publishing countries on climate change have also been the traditional powerhouses in scientific publication like the United States, United Kingdom, China, Australia, Germany, Canada, France, the Netherlands, Spain, and India, all of which are not among the most vulnerable countries affected by extreme weather.⁶

To explain such a significant discrepancy between the need and interest in climate change research and actual scientific output in this field, one should recognize the pressing nature

⁴ D. Eckstein et al., *Global Climate Risk Index 2021*, Germanwatch e.V. 2021.

⁵ P. Callow, "Storylistening's role in policy advice", *Science* vol. 379, iss. 6638, p. 1198 (2023); N. Light et al., "Knowledge overconfidence is associated with anti-consensus views on controversial scientific issues", *Science Advances* vol. 8, iss. 29 (2022).

⁶ D. Klingelhöfer et al., "Climate change: Does international research fulfill global demands and necessities?", *Environmental Sciences Europe* vol. 32, 137 (2020).

of the climate change issue, which sometimes requires a more rapid and unconventional format of publication for timelier communication among the scientific community, policy makers, and the public via channels like social media or grey literature.⁷ According to the Grey Literature International Steering Committee, grey literature is “information produced on all levels of government, academics, business and industry in electronic and print formats not controlled by commercial publishing”.⁸ Thus, by investigating the production and usage of grey literature on climate change via records like government policies, dissertations and theses, conference proceedings, technical reports, or think tank materials, we could achieve a more accurate picture on the interest in climate change research from countries highly vulnerable to this global emergency.

Climate change grey literature in INIS Repository

Although INIS was established first and foremost as a channel for IAEA Member States to exchange scientific and technical information in the nuclear field, IAEA in general and INIS in particular have for a long time recognized the close linkage between such nuclear energy and climate change, as well the need for INIS to broaden its scope to climate-related subjects. For example, IAEA Director General Rafael Mariano Grossi in 2021 stated that “governments, industries and international organizations have important roles to play in supporting innovation and the early deployment of all clean energy technologies. This is particularly critical because almost half of the emissions reductions needed to reach net zero by 2050 will have to come from new low carbon technologies, including advanced nuclear reactors. Clearly nuclear must have a seat at the table anytime energy and climate policies are discussed”.⁹ Beyond its power application for electricity generation, other non-power applications of nuclear technologies have also been recognized for their important roles in sustainable development, from sustainable agriculture, water desalination, to fighting cancer and diseases, and biodiversity support.¹⁰

Thus, among the 49 one-level broad subject categories of the scope of INIS, many have direct or indirect links to climate change, including the most assigned subject areas and citation rate of peer-reviewed papers identified by the Web of Science platform, including environmental sciences and ecology, biodiversity and conservation, meteorology and atmospheric sciences, geology, physical geography, water resources, or agriculture¹¹. These relevant subject categories are presented in Figure 2.¹²

Besides subject categories, the link between a record in the INIS Repository and climate change can also be identified by the descriptors assigned to this record by INIS, namely the technical terms from the controlled terminology of the INIS Thesaurus that were used to represent the information content of the aforementioned record.¹³ As a result, more than 30,000 records in the INIS Repository are identified to be directly related to climate change, of which 45% are journal articles, 11% are books, 22% are reports, and the rest

⁷ A. Lawrence, “Influence seekers: The production of grey literature for policy and practice”, *Information Services & Use*, vol. 37, no. 4, pp. 389-403 (2017).

⁸ Grey Literature International Steering Committee (GLISC), “Guidelines for the production of scientific and technical reports: how to write and distribute grey literature” (Nancy style), Version 1.0, March 2006, url: <http://eprints.rclis.org/7469/2/index.html>.

⁹ IAEA, “Nuclear Energy for a Net Zero World”, International Atomic Energy Agency, September 2021, url: <https://www.iaea.org/sites/default/files/21/10/nuclear-energy-for-a-net-zero-world.pdf>.

¹⁰ UNECE, “Application of the United Nations Framework Classification for Resources and the United Nations Resource Management System: Use of Nuclear Fuel Resources for Sustainable Development - Entry Pathways”, United Nations Economic Commission for Europe (UNECE), March 2021, url: <https://unece.org/sustainable-energy/publications/nuclear-entry-pathways>.

¹¹ Klingelhöfer et al., *idem*.

¹² IAEA, “Subject Categories and Scope Descriptions”, INIS/ETDE Joint Reference Series No. 2 (Rev. 1), International Atomic Energy Agency, January 2021, url: <https://inis.iaea.org/search/subject-categories/>.

¹³ IAEA, “INIS/ETDE Manual for Subject Analysis”, INIS/ETDE Joint Reference Series No. IAEA-INIS/ETDE-03, International Atomic Energy Agency, August 2012, url: <https://www.iaea.org/sites/default/files/manual-subject-analysis.pdf>.

could be categorized as grey literature, including conference proceedings, thesis, numerical data, progress report, legislative material, preprint, software, multimedia, and audio-visual files. The addition of these records to the INIS Repository is presented in Figure 3.



Figure 2. Subject categories within the INIS Scope and its relations to climate change-related subjects.



Figure 3. INIS Repository records directly related to climate change of the journal article “Articles” type, and of “Others” type, namely grey literature.

Since the main goals of grey literature are to provide evidence for policy making, to communicate with the public on policy and practice, and to translate scientific knowledge into more accessible information for the public,¹⁴ it is also necessary to examine the link between the climate change grey literature hosted by INIS and subjects of great interests by the public. On this aspect, research done by Haunschild et al. in 2019 used instances of climate change papers being mentioned on the Twitter (now X) platform to identify the recurrent terms and themes related to climate change that attract public attention, including keywords like “climate”, “climate change”, “adaptation”, “diversity”, “sustaina-

¹⁴ Lawrence, idem.

bility”.¹⁵ As presented in Figure 4, although records indexed with similar descriptors by INIS are still largely journal articles, grey literature also contributes to some extent, especially on major keywords/descriptors like “climate change”, “greenhouse gases”, “sustainability”, or “greenhouse effect”.

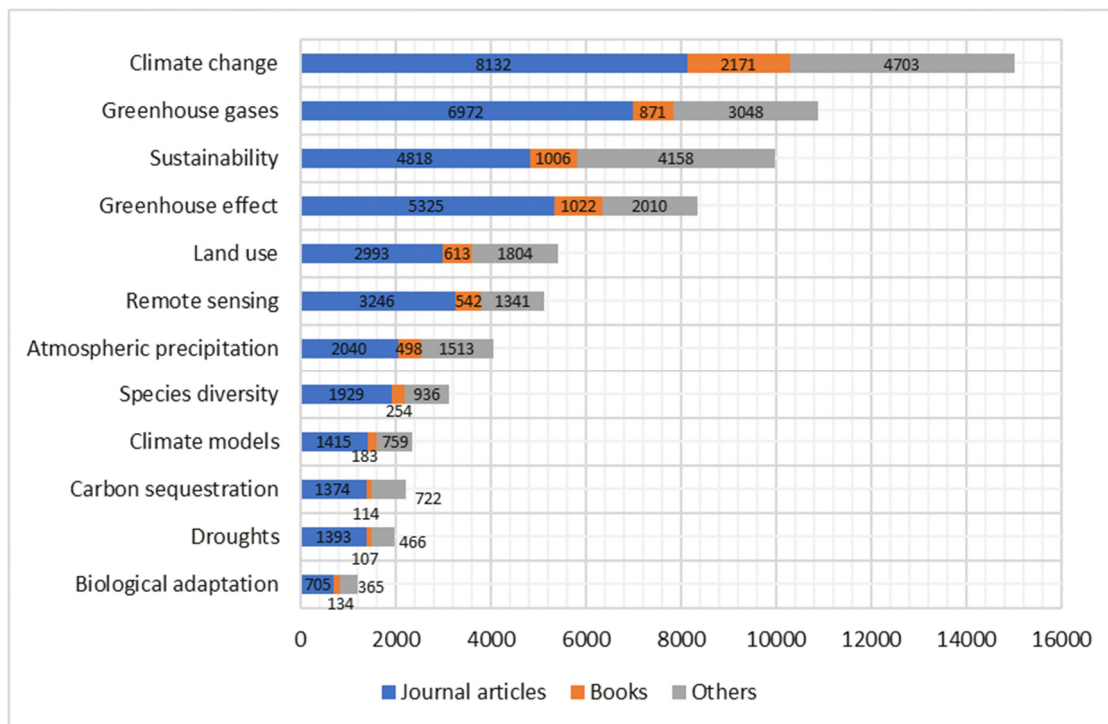


Figure 4. Climate change-related INIS Descriptors sorted by number of INIS Repository records.

Conclusions

The analysis in this paper showed that INIS has made significant effort to harvest climate change-related scientific knowledge to its Repository, including grey literature on this subject. Such effort has received positive response from public users, as two among INIS subject categories with most unique searches from 2020 to 2023 are directly related to climate change, namely Environmental Sciences (S54) and Energy Planning, Policy and Economy (S29). In addition, 25% among the top 50 INIS Repository records with most unique searches from 2020 to 2023 are climate change-related records, including not only journal articles but also grey literature pieces like conference papers or reports, on a variety of subjects like soil moisture, cow dung, waste management, burning spilled oil, or the comparison between nuclear energy and other types of clean energy.

Recently, the significant disadvantages for non-native English speakers to conduct and publish in environmental sciences were highlighted in a study done by Amano et al.¹⁶ This might be one of root causes for the interest-publication output discrepancy mentioned earlier in this paper. Therefore, despite its initial success in gaining public interest in climate change via grey literature, INIS should harvest more and in a timelier manner grey literature in languages other than English, and from lesser-exposed institutions and sources, particularly from countries heavily affected by climate change. Such approach will provide INIS with a chance to further communicate and highlight with the importance and urgency of climate change, of the linkage between nuclear energy and sustainable development, and of the role grey literature can play in scientific information exchange and climate change mitigation.

¹⁵ R. Haunschild et al., “Does the public discuss other topics on climate change than researchers? A comparison of explorative networks based on author keywords and hashtags”, *Journal of Informetrics*, vol. 13, iss. 2, pp. 695-707 (2019).

¹⁶ T. Amano et al., “The manifold costs of being a non-native English speaker in science”, *PLoS Biol*, vol. 21, iss. 7, e3002184.