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BIBLIOMETRIC ANALYSIS OF GLOBAL RESERVOIR–HYDROPOWER RESEARCH: TRENDS, THEMATIC EVOLUTION AND MODELING PERSPECTIVES.

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Abstract. Reservoirs are essential for hydropower systems because they regulate water availability, maintain operational head, and stabilize flow conditions for efficient turbine performance. Recent studies increasingly focus on improving storage efficiency, reducing water losses, and monitoring hydrodynamic and sedimentation processes that affect energy production. This study applies bibliometric analysis to examine reservoir-related research with an emphasis on energy-oriented themes. A total of 393 publications from 2015 to 2026 were retrieved from the Scopus database. The results show that the field is dominated by journal articles and conference papers, while Engineering, Energy, and Environmental Science are the leading subject areas. China, Italy, and the United States are the most productive countries, with strong contributions from major universities and active researchers. Overall, the findings confirm that numerical, mathematical, and hydrodynamic modelling remain central directions in reservoir–hydropower research.

Keywords: energy, hydropower, turbine, water, Scopus ,WOSviewer,bibliometric analysis, hydrodynamic modelling, climate change, reservoir operation

Аннотация. Водохранилища играют ключевую роль в гидроэнергетических системах, поскольку они регулируют водные ресурсы, поддерживают рабочий напор и стабилизируют условия потока для эффективной работы турбин. В последние годы исследования все чаще направлены на повышение эффективности аккумулирования воды, снижение потерь и мониторинг гидродинамических и седиментационных процессов, влияющих на выработку энергии. В данном исследовании применяется

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библиометрический анализ для изучения научных работ, связанных с водохранилищами, с акцентом на энергетические аспекты. Всего было проанализировано 393 публикации за период с 2015 по 2026 годы, отобранные из базы данных Scopus. Результаты показывают, что основную долю составляют журнальные статьи и материалы конференций, при этом ведущими научными областями являются инженерия, энергетика и экология. Китай, Италия и США являются наиболее продуктивными странами, с активным вкладом ведущих университетов и исследователей. В целом, полученные результаты подтверждают, что численные, математические и гидродинамические модели остаются ключевыми направлениями исследований в области гидроэнергетики и водохранилищ.

Ключевые слова: энергия, гидроэнергетика, турбина, вода, Scopus, VOSviewer, библиометрический анализ, гидродинамическое моделирование, изменение климата, управление водохранилищами.

Annotatsiya. Suv omborlari gidroenergetika tizimlarida muhim ahamiyatga ega bo‘lib, ular suv resurslarini tartibga soladi, ishchi bosimni saqlaydi va turbinalarning samarali ishlashi uchun oqim sharoitlarini barqarorlashtiradi. So‘nggi yillarda tadqiqotlar suvni saqlash samaradorligini oshirish, yo‘qotishlarni kamaytirish hamda energiya ishlab chiqarishga ta’sir etuvchi gidrodinamik va cho‘kindi jarayonlarni monitoring qilishga ko‘proq qaratilmoqda. Ushbu tadqiqotda suv omborlariga oid ilmiy ishlanmalarni energiya yo‘nalishida tahlil qilish uchun bibliometrik usul qo‘llanildi. Scopus ma’lumotlar bazasidan 2015–2026 yillar oralig‘ida chop etilgan jami 393 ta maqola tanlab olindi. Natijalar shuni ko‘rsatadiki, ilmiy ishlarning asosiy qismini jurnal maqolalari va konferensiya materiallari tashkil etadi, yetakchi yo‘nalishlar esa muhandislik, energetika va ekologiya hisoblanadi. Xitoy, Italiya va AQSh eng faol mamlakatlar bo‘lib, yetakchi universitetlar va tadqiqotchilar muhim hissa qo‘shgan. Umuman olganda, natijalar shuni tasdiqlaydiki, sonli, matematik va gidrodinamik modellashtirish suv omborlari va gidroenergetika sohasidagi asosiy ilmiy yo‘nalishlar bo‘lib qolmoqda.

Kalit so‘zlar: energiya, gidroenergetika, turbina, suv, Scopus, VOSviewer, bibliometrik tahlil, gidrodinamik modellashtirish, iqlim o‘zgarishi, suv omborlarini boshqarish

INTRODUCTION.

Reservoirs are essential for regulating river flow and ensuring reliable water supply for agriculture and hydropower. By controlling inflow, maintaining operational head, and stabilizing flow conditions, they directly support turbine performance and energy production [1–3]. As water and energy demand continues

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to grow, sustainable reservoir management has become increasingly important. Recent studies therefore focus on improving storage efficiency, reducing water losses, and monitoring hydrodynamic and sedimentation processes that affect reservoir capacity and long-term hydropower performance [4–8]. Reservoir processes are governed by flow velocity, pressure gradients, and friction, which influence sediment transport, erosion, siltation, and morphological changes. These factors create challenges for reservoir operation and storage preservation, especially under changing hydrological conditions [9,10]. Because of this complexity, mathematical and numerical modelling has become a key approach for analyzing reservoir behavior and supporting operational decisions, especially where physical experiments are costly [11–14]. In this context, bibliometric analysis provides a useful framework for identifying major trends, leading contributors, and evolving research themes in reservoir–hydropower studies [15,16].

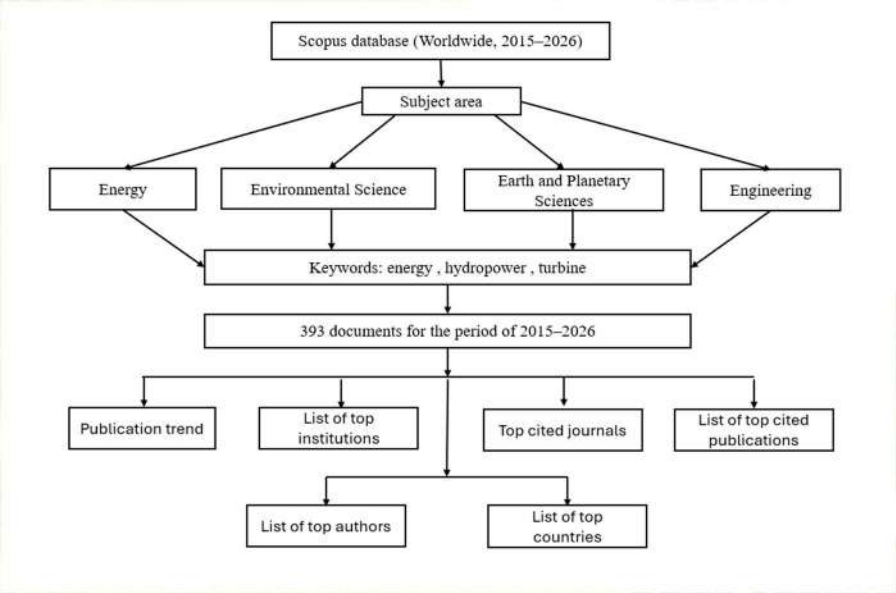


Figure 1: Scheme of the study methodology.

In the final stage, bibliometric mapping tools were used to analyze co-authorship, keyword co-occurrence, thematic evolution, and the contributions of countries and institutions in the Scopus dataset for 2015–2026 (n = 393). For this purpose, VOSviewer and Biblioshiny were applied [11,12]. In VOSviewer, node size reflects item weight, links indicate relationships, and shorter distances show stronger connections.

RESULTS AND DISCUSSION

A total of 393 Scopus-indexed documents published between 2015 and 2026 addressed reservoir–hydropower systems and turbine-related water processes. The main subject areas were Engineering (22.9%), Energy (20.7%), Environmental Science (14.4%), Mathematics (7.4%), Computer Science (6.2%), Social Sciences

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(5.0%), and Physics and Astronomy (4.8%). Other contributions came from Agricultural and Biological Sciences (3.3%), Biochemistry, Genetics and Molecular Biology (2.7%), Chemical Engineering (2.6%), and other fields (9.9%).

Overall, the results confirm the interdisciplinary nature of reservoir–hydropower research. Publication output also showed a clear increasing trend over the selected period, indicating growing scientific interest in the topic (Figure 2).

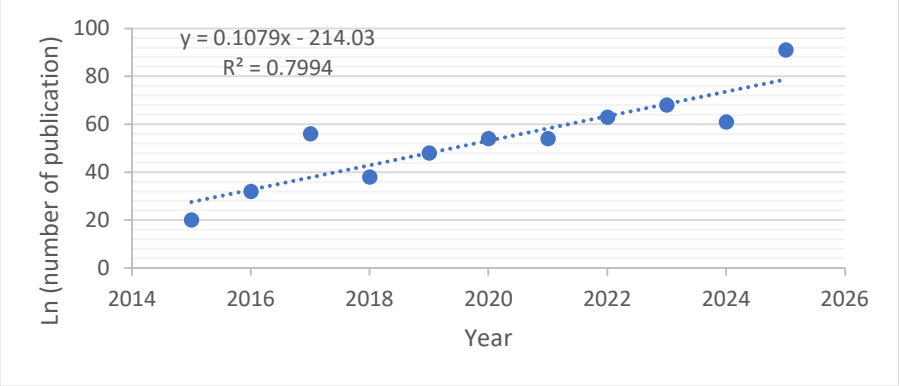


Figure 2: Trend in publications on reservoir research between 2015 and 2026.

The analysis also shows that the field is mainly shaped by engineering- and energy-related perspectives, while environmental and modelling-oriented disciplines play an increasingly important supporting role [2, 6, 12]. In terms of geographical distribution, China ranks first in the dataset, followed by Italy and the United States, while additional contributions are observed from countries such as Indonesia and India. Institutional productivity further reveals the presence of active scientific centers, with Tsinghua University and Wuhan University among the most productive affiliations within the analyzed dataset.

Authors and their affiliated institutions. A total of authors were identified during the analysis of publications related to reservoir–hydropower systems and turbine-relevant water processes. The top 10 most productive authors are presented in Figure 3. These authors contributed approximately 18.8% of the total publications. Among them, Quaranta, E. and Ramos, H.M. recorded the highest output, with 10 documents each, followed by Sinagra, M. and Tucciarelli, T., with 9 publications each. McNabola, A. contributed 8 publications, while Fontana, N., Marini, G., and Picone, C. each produced 6 documents. In addition, Aricò, C. and Guo, W. each contributed 5 research papers. Overall, the results indicate that scientific production in this field is concentrated within a relatively small group of highly productive researchers, a pattern commonly observed in bibliometric studies of specialized research domains

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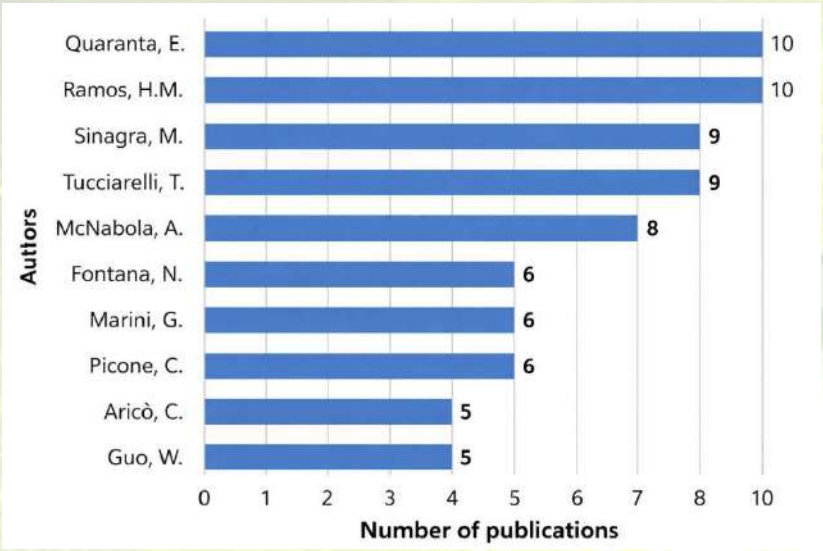


Figure 3: List of top 10 authors published on reservoir–hydropower research.

The results indicate that Tsinghua University and Wuhan University rank first in the dataset, with 14 records each, followed by Instituto Superior Técnico and Universidade de Lisboa, each with 13 records. Trinity College Dublin ranks next with 11 records, while Hohai University, École Polytechnique Fédérale de Lausanne, and CERIS – Civil Engineering Research and Innovation for Sustainability each contributed 10 records. In addition, Università degli Studi di Palermo produced 9 records, and The Hong Kong Polytechnic University contributed 8 records. Overall, the institutional distribution indicates that research output in this area is concentrated within a relatively small group of active universities and research centers, which play a significant role in advancing hydropower, energy efficiency, and reservoir management studies.

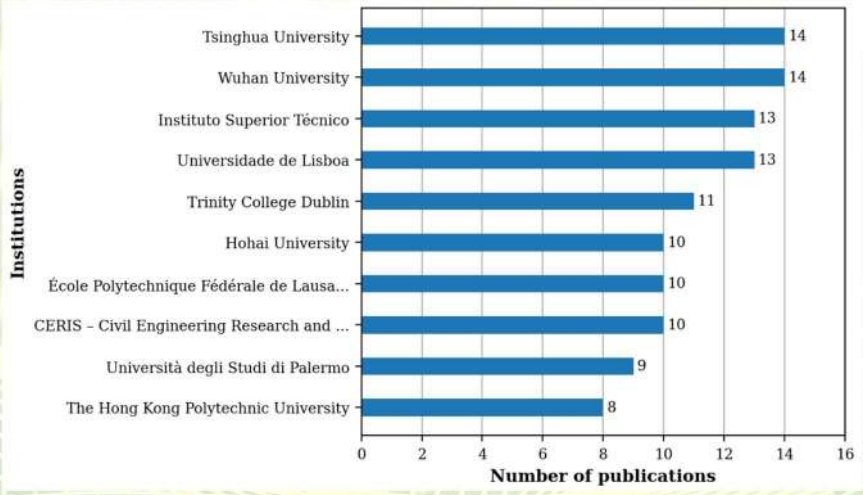


Figure 4: Top institutions in reservoir–hydropower research.

Top countries in reservoir–hydropower research. Countries whose energy and water sectors are strongly dependent on water resources are increasingly focusing on reservoir operation, hydropower generation, turbine performance, and

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related hydraulic processes. The most productive countries within the analyzed Scopus dataset for 2015–2026 (n = 393) are presented in Figure 5. China leads the field with 86 documents, followed by Italy with 45, the United States with 29, Indonesia with 26, and India with 22. Spain and Portugal each contributed 17 documents, while Switzerland, Malaysia, and Germany each accounted for 16 documents. Further contributions were observed from the Russian Federation (13), the United Kingdom (12), Ireland (12), and Iran (12), with Norway contributing 11 documents. Overall, these results indicate that reservoir–hydropower research is globally distributed but strongly concentrated in a limited number of highly productive countries, reflecting both strong research capacity and active engagement in energy–water nexus challenges.

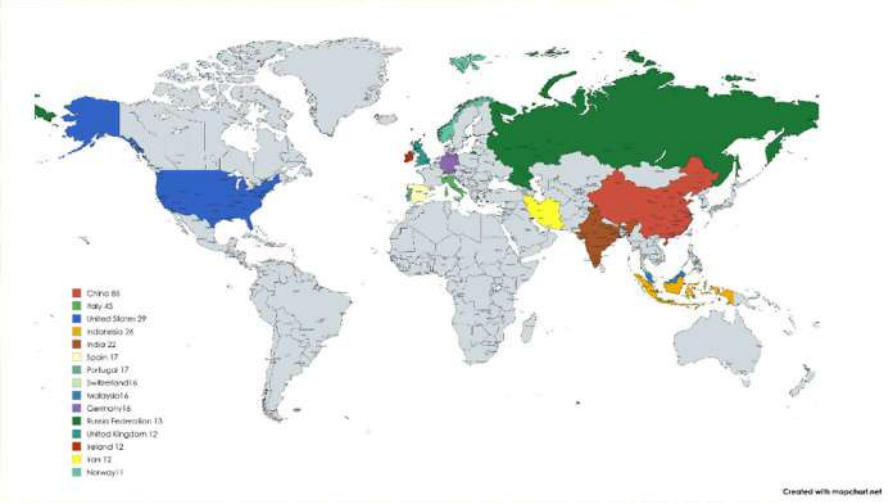


Figure 5: List of top countries in reservoir–hydropower research.

From the above, it is evident that, according to the analysis of countries, affiliated institutions, and authors, a considerable share of studies on reservoir–hydropower systems and energy-related water processes is produced by a limited number of highly active scientific communities and institutions. In particular, China holds a leading position in the dataset in terms of publication output, followed by several European countries and the United States. One possible reason is the country's strong need to improve water and energy resource management under conditions of uneven water distribution and increasing hydropower demand [3, 8, 9]. In addition, China's leading role may be associated with the presence of numerous well-established universities, research laboratories, and engineering centers actively engaged in hydropower, reservoir operation, and water–energy system optimization.Top cited papers and journals on reservoir–hydropower research. Academic influence in a research field is commonly assessed through citation analysis [11, 12]. However, citation count alone does not always fully reflect the scientific significance of a publication, since journal prestige and scope also affect its visibility and impact [12]. Table 1 presents the most influential

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articles in reservoir–hydropower and energy-related water systems based on citation performance. The analysis of highly cited papers indicates that recent research has focused mainly on hydropower optimization, reservoir operation, water–energy system modelling, sustainability assessment, and climate-related effects on energy generation.

No	Title	Journal	Corresponding author	PY	TC	Citation per year	Document type
1	Operation of Hydro Power Plants: A Review	Renewable and Sustainable Energy Reviews	Singh, V.K.	2017	280	28	Review article
2	A Review of Reservoir Operation Optimisations: from Traditional Models to Metaheuristic Algorithms	Archives of Computational Methods in Engineering	Lai, V.	2022	116	23.2	Review article
3	Optimal Operation of Hydropower Reservoirs under Climate Change: The Case of Tekeze Reservoir, Eastern Nile	Water	Abera, F.F.	2018	88	9.8	Article
4	Hydropower Operation Optimization Using Machine Learning: A	AI	Bernardes, J., Jr.	2022	6	17.2	Review article

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	Systematic Review						
5	A Bird's Eye View of Pumped Hydro Energy Storage: A Bibliometric Analysis of Global Research Trends and Future Directions	Journal of Energy Storage	Odoi-Yorke, F.	2024	46	15.3	Review article
6	Reservoir Volume Forecasting Using Artificial Intelligence-Based Models	Journal of Hydrology	Özdoğan-Sarıkoç, G.	2023	46	11.5	Article
7	Monthly Agricultural Reservoir Storage Forecasting Using Artificial Intelligence Techniques	Atmospher e	Kim, S.J.	2022	7	1.4	Article

The data presented in Table 1 and Figure 6 show that [Journal name 1], with an impact factor of [IF], is one of the leading journals for publishing research on reservoir–hydropower systems and energy-related water processes. Therefore, the results of the analysis indicate that 393 documents received [total citations] citations across [number of journals] journals. Figure 6 presents the top 10 journals with more than [threshold] citations from publications published between 2015 and

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2026. A substantial share of the total citation impact is concentrated in the top three journals: [Journal 1] with [x] citations, [Journal 2] with [y] citations, and [Journal 3] with [z] citations (Figure 6). This pattern suggests that scientific visibility and citation influence in reservoir–hydropower research are concentrated in a limited number of high-impact publication outlets, which play a key role in shaping the development and dissemination of knowledge in this field.

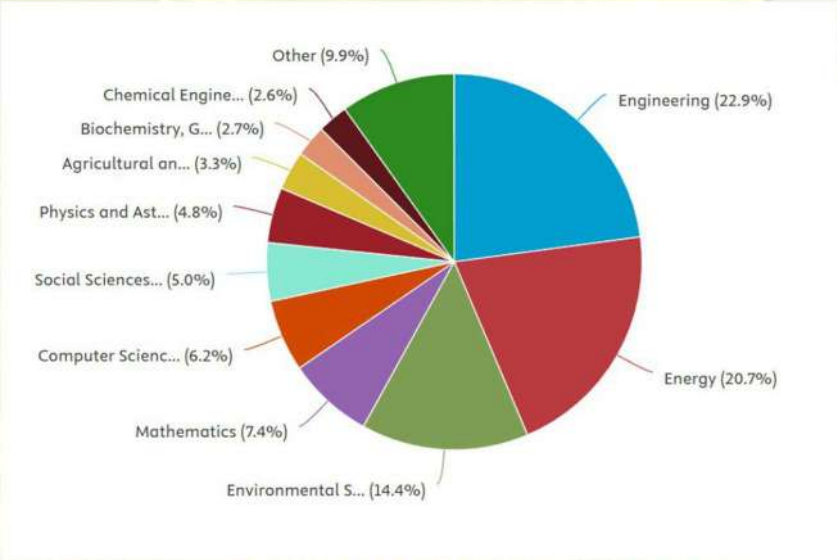


Figure 6: Top cited journals in reservoir–hydropower research.

Analysis of co-authors and keywords. Co-authorship analysis in bibliometric research examines collaboration patterns among authors, institutions, and countries. It helps reveal scientific cooperation networks, the structure of research communities, and the intensity of knowledge exchange within a field. In this study, based on Scopus data, VOSviewer was used to construct maps of co-authorship and keyword co-occurrence in reservoir–hydropower research and energy-related water systems. The co-authorship analysis identified a network of [total number of authors] authors, of whom those with at least [minimum threshold] publications were included in the visualization. As a result, [number of items] items were selected and grouped into [number of clusters] clusters, reflecting different collaboration patterns in the field. The distribution of these items suggests that scientific production is centered around several active research groups, with some clusters showing stronger and denser collaboration links than others (Figure 7).

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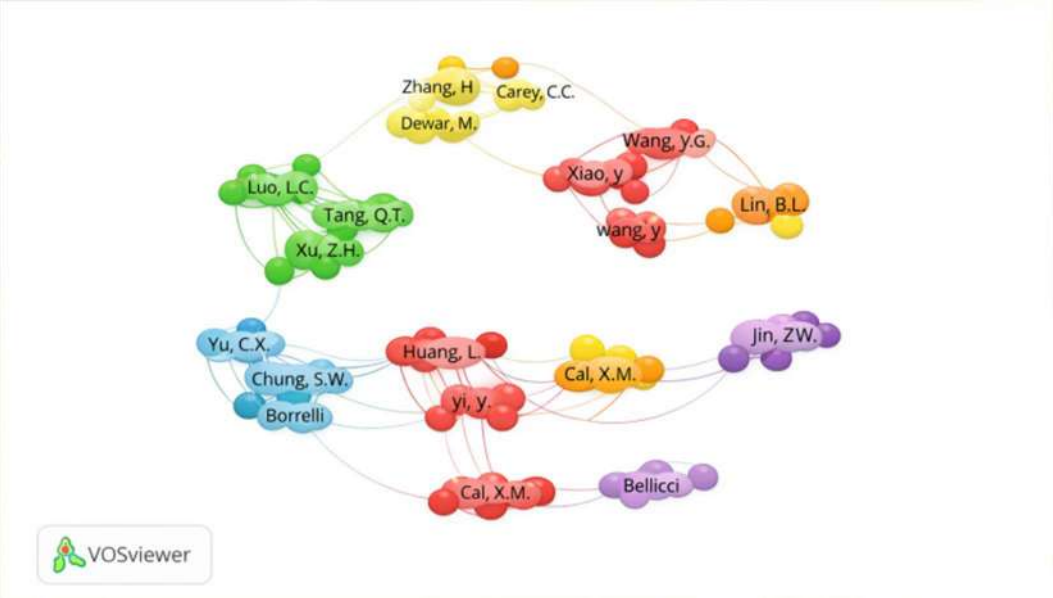


Figure 7: A network map of top co-authors based on overall link strength.

The keyword co-occurrence analysis further provides insight into the main research directions and thematic structure of the field. The most frequent keywords are related to hydropower, reservoir operation, optimization, sustainability, energy efficiency, and other energy-oriented water processes. The clustering of these keywords indicates that recent studies increasingly emphasize the integration of hydraulic, environmental, and energy-related approaches, which confirms the interdisciplinary nature of reservoir–hydropower research.

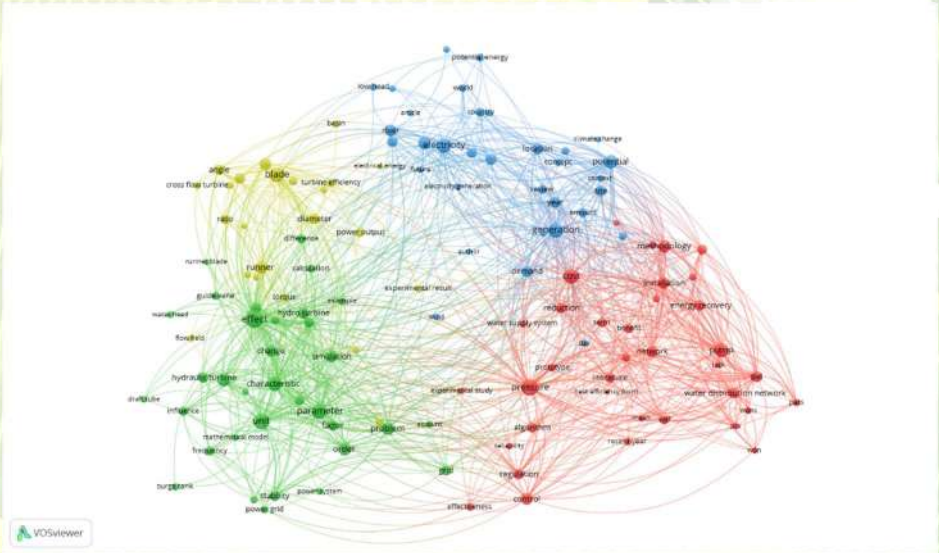


Figure 8. Keyword co-occurrence network map of the top keywords based on total link strength.

Based on the total link strength, each keyword was represented as a node in the network map, where node size indicates keyword importance and the distance between nodes reflects thematic relatedness. The selected keywords were grouped into four clusters (Figure 8). The blue cluster relates mainly to electricity generation

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and hydropower potential assessment; the red cluster to pressure-driven energy recovery and water-network applications; the green cluster to modelling and system performance; and the yellow cluster to turbine design and efficiency improvement. Overall, the network shows that the field is structured around four main pillars: potential assessment, energy recovery, modelling and stability, and turbine optimization.Thematic evolutions and interrelationship analysis.Thematic evolution analysis was used to identify the main stages of development in reservoir–hydropower research during 2015–2026. For this purpose, the publications were divided into four periods: 2015–2017, 2018–2020, 2021–2023, and 2024–2026 (Figure 9). In the first stage, research mainly focused on hydropower, reservoir systems, generation, and simulation. In the second stage, the thematic structure expanded, although simulation remained central. In the third stage, greater attention was given to optimization, energy efficiency, sustainability, and integrated water–energy management. In the final stage, the number of recurring themes increased significantly, showing a broader and more interconnected research structure involving hydropower engineering, reservoir operation, environmental assessment, and energy system analysis.

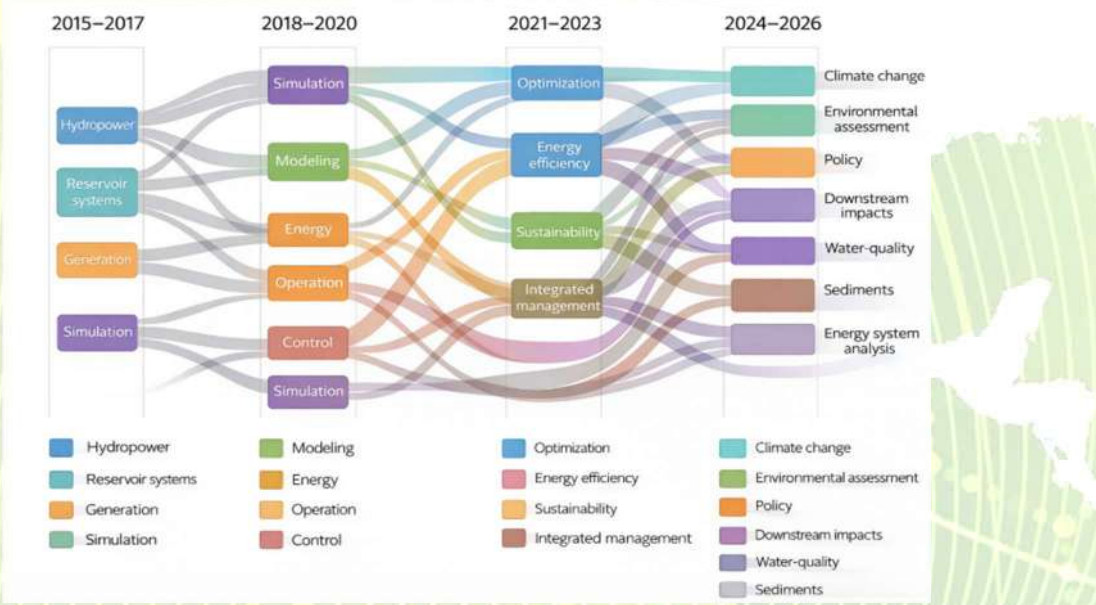


Figure 9: Thematic evolutions in years.

As illustrated in Figure 9, the number of themes in the final stage was almost three times higher than in the first and second periods. During this phase, scientific publications on reservoirs increasingly focused on sediment, suspended sediment, sediment transport, water quality, and hydrodynamics. Throughout all four stages of the analysis, the themes “sediment,” “dynamics,” and “reservoir” consistently appeared as dominant topics. The interrelationship analysis among countries, institutions, and research fields also confirmed the leading position of these themes

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(Figure 10). This indicates that these topics are likely to remain major directions of reservoir research in the coming decade.

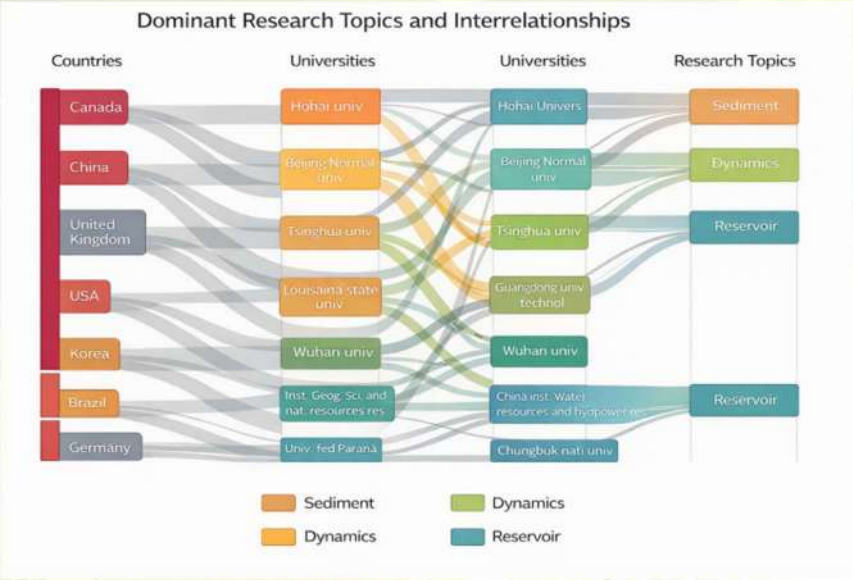


Figure 10: Interrelationship analysis: focus of countries and institutions

The objective of this research was to examine the existing knowledge on reservoir–hydropower systems and identify the most influential research areas in this field. The analysis shows that the dominant topics are hydropower generation, simulation, pressure, pump systems, and electricity production [8, 10, 11]. Particular attention has been given to modelling and optimization approaches for evaluating system performance.Overall, the field is strongly oriented toward simulation, system analysis, and engineering optimization. Many publications are based on numerical, mathematical, hydrodynamic, and optimization-based methods (Table 2). These approaches are widely used to assess hydropower efficiency, turbine and pump performance, electricity generation potential, and the operation of water-related energy systems.

CONCLUSION. Reservoir-based systems are essential for both water management and energy production, especially in hydropower. This study analyzed 393 Scopus-indexed documents (2015–2026) and showed that reservoir–hydropower research has developed as an interdisciplinary field mainly shaped by engineering and energy-related perspectives. Publication output increased over time, while China emerged as the leading contributor, with Tsinghua University and Wuhan University among the most productive institutions.

The results further indicate that the field is strongly influenced by modelling, simulation, and optimization-based studies. The most prominent themes include hydropower generation, reservoir operation, pressure, pump systems, electricity,

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and system performance. Citation analysis also showed that scientific influence is concentrated in a limited number of highly visible journals and publications.

Overall, reservoir–hydropower research is increasingly moving toward an integrated framework combining hydraulic engineering, energy efficiency, optimization, and environmental assessment. The findings suggest that these themes will remain among the main research directions in the coming years.

REFERENCES

1. Singh, V. K., and S. K. Singal. 2017. *Operation of Hydro Power Plants: A Review.* Renewable and Sustainable Energy Reviews 69: 610–619. doi:10.1016/j.rser.2016.11.169.

2. Dogan, M. S., J. Medellin-Azuara, and J. R. Lund. 2024. *Hydropower Reservoir Optimization with Solar Generation-Changed Energy Prices in California.* Water Resources Management 38 (6): 2135–2153. doi:10.1007/s11269-024-03747-6.

3. Zhang, Y., H. Ma, and S. Zhao. 2021. *Assessment of Hydropower Sustainability: Review and Modeling.* Journal of Cleaner Production 321: 128898. doi:10.1016/j.jclepro.2021.128898.

4. Tahseen, S., and B. W. Karney. 2017. *Reviewing and Critiquing Published Approaches to the Sustainability Assessment of Hydropower.* Renewable and Sustainable Energy Reviews 67: 225–234. doi:10.1016/j.rser.2016.09.031.

5. Abera, F. F., D. H. Asfaw, A. N. Engida, and A. M. Melesse. 2018. *Optimal Operation of Hydropower Reservoirs under Climate Change: The Case of Tekeze Reservoir, Eastern Nile.* Water 10 (3): 273. doi:10.3390/w10030273.

6. Lai, V., Y. F. Huang, C. H. Koo, A. N. Ahmed, and A. El-Shafie. 2022. *A Review of Reservoir Operation Optimisations: From Traditional Models to Metaheuristic Algorithms.* Archives of Computational Methods in Engineering 29 (5): 3435–3457. doi:10.1007/s11831-021-09701-8.

7. Lu, S., W. Dai, Y. Tang, and M. Guo. 2020. *A Review of the Impact of Hydropower Reservoirs on Global Climate Change.* Science of the Total Environment 711: 134996. doi:10.1016/j.scitotenv.2019.134996.

8. Asadieh, B., and A. Afshar. 2019. *Optimization of Water-Supply and Hydropower Reservoir Operation Using the Charged System Search Algorithm.* Hydrology 6 (1): 5. doi:10.3390/hydrology6010005.

9. Tao, Y., L. Mo, Y. Yang, Z. Liu, Y. Liu, and T. Liu. 2023. *Optimization of Cascade Reservoir Operation for Power Generation, Based on an Improved Lightning Search Algorithm.* Water 15 (19): 3417. doi:10.3390/w15193417.

10. Saab, S. M., M. A. Al-Zahrani, H. A. B. Sidhu, and M. A. Alojail. 2022. *Review on Generating Optimal Operation for Dam and Reservoir Water System:*

ISSN 3030-3907

Simulation Models and Optimization Algorithms. Applied Water Science 12: 143. doi:10.1007/s13201-022-01593-8.

11. Van Eck, N. J., and L. Waltman. 2010. *Software Survey: VOSviewer, a Computer Program for Bibliometric Mapping.* Scientometrics 84 (2): 523–538. doi:10.1007/s11192-009-0146-3.

12. Jiang, H., M. Qiang, and P. Lin. 2016. *A Topic Modeling Based Bibliometric Exploration of Hydropower Research.* Renewable and Sustainable Energy Reviews 57: 226–237. doi:10.1016/j.rser.2015.12.194.

13. Odoi-Yorke, F., A. A. Abbey, T. A. Frimpong, E. Asante, E. M. Amewornu, J. E. Davis, E. B. Agyekum, and L. Atepor. 2024. *A Bird's Eye View of Pumped Hydro Energy Storage: A Bibliometric Analysis of Global Research Trends and Future Directions.* Journal of Energy Storage 100: 113594. doi:10.1016/j.est.2024.113594.

14. Bernardes, J., Jr., M. Santos, T. Abreu, L. Prado, Jr., D. Miranda, R. Julio, P. Viana, M. Fonseca, E. Bortoni, and G. S. Bastos. 2022. *Hydropower Operation Optimization Using Machine Learning: A Systematic Review.* AI 3 (1): 78–99. doi:10.3390/ai3010006.

15. Peng, Y., G. Wang, G. Tang, et al. 2011. *Study on Reservoir Operation Optimization of Ertan Hydropower Station Considering GFS Forecasted Precipitation.* Science China Technological Sciences 54 (Suppl 1): 76–82. doi:10.1007/s11431-011-4623-6.

16. Akkaya Oy, S., S. İnal, and A. Özdemir. 2024. *Operation of Hydroelectric Power Plants, Dam Reservoirs, and Energy Trade Using Artificial Neural Networks.* Applied Sciences 15 (1): 183.

ISSN 3030-3907