Mapping the Maldives Research Ecosystem: Publication Output, Collaboration, and Research Gaps

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HIGHLIGHTS

- Maps Maldives-related research (2000–2025) as a national research ecosystem, not just output
- Analyses 2,645 validated records combining OpenAlex, Crossref, and local-source data
- Finds local participation of 37.8% but validated local leadership of only 20.2%
- Shows research visibility has grown faster than proportional local leadership
- Identifies research evidence gaps in governance, infrastructure, and digital systems

ABSTRACT

Small island states need research systems that generate visible, accessible, and locally led rigorous research evidence for policy action. However, national research capacity is often assessed through publication counts alone, which can obscure who leads research, which institutions participate, and where evidence gaps remain. This study mapped Maldives-specific research output from 2000 to 2025 as a national research ecosystem. A bibliometric and policy-alignment design was used, combining OpenAlex retrieval, Crossref validation, local-source supplementation, duplicate resolution, and validated authorship classification. Records were classified by Maldives affiliation, Maldives focus, local participation, local leadership, external authorship, international co-production, thematic field, open-access status, and United Nations'Sustainable Development Goals (SDGs) alignment. The final analytical sample contained 2,645 validated records. Output expanded sharply in recent years, with 55.7% of records published from 2021 to 2025. The evidence base was concentrated on climate and environment, with 897 records, health and wellbeing, with 780 records, and fisheries and ocean research, with 350 records, while governance, infrastructure, culture, inequality, water and sanitation, and digital systems were less visible. Among 1,583 Maldives-focused records, only 598 included a Maldives-based author, giving a local participation rate of 37.8%. Only 319 Maldives-focused records were locally led, giving a local leadership rate of 20.2%, while 985 records had no validated local authorship, giving a share of 62.2%. Among Maldives-affiliated records, 74.3% involved international co-production. SDG tagging showed strong visibility for Life Below Water, Good Health and Well-being, Quality Education, Decent Work and Economic Growth, and Climate Action, but weaker visibility for several implementation-relevant SDGs. The findings show that Maldives-related research output has grown rapidly, but visibility has not translated into proportional local research leadership. Strengthening the Maldives research ecosystem will require locally led research, equitable collaboration, stronger local journals, better metadata, open evidence, and targeted support for underrepresented policy areas.

KEYWORDS

Maldives
Small Island Developing States
Research Ecosystem
Local Leadership
Sustainable Development Goals
Open Science
Research Policy

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INTRODUCTION

Small island developing states (SIDS) require research systems that can support decisions across climate adaptation, natural and built environment, livelihoods, health, education, social justice, governance, and sustainable development, for socio-economic development. In these countries, research output is not only an academic productivity indicator. It is part of national policy capacity because it shapes which problems are studied, whose expertise is recognised, and how evidence enters public decision-making. The Antigua and Barbuda Agenda for Small Island Developing States frames resilient prosperity as a central development priority for small island states over the next decade (United Nations General Assembly, 2024). The United Nations High-Level Panel on the Development of a Multidimensional Vulnerability Index also argues that small states face structural vulnerabilities that are not adequately captured by income-based indicators alone (United Nations High-Level Panel on the Development of a Multidimensional Vulnerability Index, 2024). For such countries, mapping research output can show where evidence is visible, where knowledge is locally led, locally produced, and where development priorities remain weakly supported.

Research capacity is an essential element of development infrastructure. SDG indicator 9.5 monitors scientific research and innovation through indicators such as research and development expenditure as a share of GDP and researchers per million inhabitants (UNESCO Institute for Statistics, 2025). For small island states, this measurement problem is also a data-capacity problem. Hambleton and Jeyaseelan (2024) show that SIDS face weaker statistical capacity and lower availability of SDG and gender-disaggregated data than many other world regions. If data, publications, local journals, institutional affiliations, and authorship leadership are poorly documented, national research capacity can be underestimated even when relevant work exists.

The Maldives is a high-value case for this type of analysis. The 2022 Population and Housing Census recorded enumeration across 187 inhabited islands, 168 resorts, and 106 industrial islands, showing a highly dispersed national geography (Maldives Bureau of Statistics, 2024). This geography creates a distinctive evidence challenge because public services, infrastructure, livelihoods, environmental exposure, and development planning are spread across administrative and non-administrative islands. The country's development pathway is also closely tied to climate-sensitive sectors. The World Bank Group (2024) identifies tourism, fisheries, natural capital, coral reefs, and climate resilience as central to the Maldives' climate-development trajectory. Maldives' 2023 Voluntary National Review identifies decentralisation, economic and climate resilience, human wellbeing, gender equality, and connectivity as priorities for SDG acceleration (Government of Maldives, 2023). UNDP's SDG Insights for Maldives also links national SDG commitments to wellbeing, climate action, and sustainable cities and communities (United Nations Development Programme, 2024). These signals make Maldives-related research a development issue, not only a bibliographic one.

Climate adaptation further strengthens the need for a research-ecosystem approach. Thomas and Theokritoff (2024) show that small island developing states identify multiple adaptation constraints, with finance emerging as a major constraint and governance among the key enabling conditions. For the Maldives, this means that climate and development research must be assessed not only by how much is published, but also by whether the evidence base supports domestic institutions, policy implementation, and locally relevant decision-making. A country can be highly visible in global climate or marine research while still having limited local leadership over the questions, interpretations, and outputs that shape its evidence base.

Research mapping is useful for this problem, but only if it goes beyond simple output counting. Bibliometric studies can identify publication trends, collaboration structures, influential sources, and thematic patterns. However, recent methodological guidance warns that bibliometric work is weak when it stops at descriptive maps without explaining implications for theory, policy, or practice (Hulland, 2024; Mukherjee et al., 2022). This concern is central to a national research-ecosystem study. A rising publication count may hide weak local leadership, limited access to evidence, narrow thematic concentration, or external dominance of research about the country. The present study therefore treats metrics as interpretive evidence for understanding knowledge production, not as direct measures of research quality.

A national research-ecosystem approach must distinguish between research produced by Maldivian institutions and research conducted about the Maldives. These categories overlap, but they are not the same. Some studies include Maldives-based authors but address wider regional or global questions. Other studies examine Maldives' reefs, tourism, health, education, governance, climate vulnerability, or economy without identifiable Maldives-based authorship. This distinction matters because a country may be visible as a research object without being equally visible as a research leader. The present study therefore examines Maldives-related research output through categories of affiliation, focus, leadership, co-production, and external authorship.

The local scholarly setting also supports this approach. Maldives-related research is not produced only through internationally indexed journals. Local multidisciplinary outlets such as the Maldives National Journal of Research and the International Journal of Social Research and Innovation provide publication spaces for nationally relevant work in education, health, public policy, law, business, language, culture, and social research (International Journal of Social Research and Innovation, n.d.; Maldives National University, n.d.). These sources matter because local journals and institutional outputs may be less visible in global bibliographic databases, leading to underestimation of national research capacity.

SDG alignment gives this study its policy lens. The SDGs are used to examine whether Maldives-related research output corresponds to national evidence needs. If research output is concentrated in a few visible sectors while areas such as social protection, quality education, public health systems, labour, digital governance, ageing, disability, decentralised services, institutional reform, water and sanitation, or urban resilience receive limited attention, then publication growth may coexist with serious evidence gaps. This study maps Maldives-related scholarly output from 2000 to 2025 as a national research ecosystem. It asks how output has changed over time, which disciplines and institutions dominate, what proportion of research is locally led or externally led, which SDGs are most and least represented, and where the main evidence gaps lie relative to the Maldives' development priorities and small island policy needs.

METHOD

Study Design

This study used a bibliometric and policy-alignment design to map Maldives-related scholarly output from 2000 to 2025. Bibliometric analysis was suitable because it supports systematic examination of publication growth, source distribution, collaboration structures, research visibility, and thematic patterns within a defined literature corpus (Donthu et al., 2021). The study was designed as a national research-ecosystem analysis, not as a ranking exercise. It examined how Maldives-related knowledge is produced, accessed, led, and aligned with development priorities.

The design followed guidance that bibliometric research should connect descriptive mapping to theory, policy, and practice (Hulland, 2024; Mukherjee et al., 2022). It also followed bibliometric design principles that emphasise alignment between research purpose, data-source selection, cleaning procedures, indicators, and reporting structure (Öztürk et al., 2024). Indicators were interpreted as contextual evidence and not as direct measures of quality, consistent with responsible research-assessment principles in the San Francisco Declaration on Research Assessment, the Agreement on Reforming Research Assessment, and the Leiden Manifesto (Declaration on Research Assessment, 2012; Coalition for Advancing Research Assessment, 2022; Hicks et al., 2015).

Data Sources and Retrieval

OpenAlex was used as the primary bibliographic source because it is a fully open scholarly knowledge graph covering works, authors, sources, institutions, and concepts (Priem et al., 2022). It supports reproducible retrieval through a public API and provides fields required for this study, including publication year, work type, DOI, citation count, open-access status, author affiliations, institution country codes, topics, concepts, and SDG tags, drawing on the OpenAlex works-filter and SDG-classification documentation (OpenAlex, n.d.-a, n.d.-b). Crossref was used to validate DOI-bearing records and check publication dates, source titles, licenses, and publisher metadata where needed (Crossref, n.d.).

Retrieval used three channels. The first identified Maldives-affiliated research output through OpenAlex affiliation metadata, using Maldives institutional country information as an initial signal. The second identified Maldives-focused research through title and abstract searches using the terms Maldives, Maldivian, Dhivehi, Male Maldives, and Malé Maldives. The third identified local scholarly outputs from recognised Maldives-based sources, especially the Maldives National Journal of Research and the International Journal of Social Research and Innovation. Google Scholar was not used as a primary source because its retrieval and export processes are less reproducible than structured bibliographic APIs. This choice favoured reproducibility, but it may reduce coverage of grey literature and locally published or non-indexed outputs that Google Scholar sometimes surfaces, a trade-off acknowledged among the study limitations. Search date, source, query, filter, raw count, and output file were recorded in a search log.

Eligibility Criteria

Records were included when they met at least one of three criteria. First, at least one author was affiliated with a Maldives-based institution. Second, the Maldives was a substantive focus of the work as a country, case, study site, population, ecosystem, economy, policy object, or development setting. Third, the record appeared in a

recognised Maldives-based scholarly outlet and had sufficient bibliographic metadata for analysis.

Eligible outputs included journal articles, reviews, conference papers, book chapters, dissertations, datasets, scholarly reports, and other research outputs with scholarly metadata. Editorials, commentaries, and short communications were included only when they contained substantive research, policy analysis, or evidence synthesis. Records were excluded when the Maldives appeared only in a reference list, author biography, affiliation fragment, or passing mention. News items, promotional texts, travel writing, blogs, non-scholarly webpages, and records lacking essential bibliographic information were excluded unless missing fields could be verified.

Data Cleaning, Validation, and Duplicate Resolution

Data cleaning followed recent guidance on combining and cleaning bibliometric records from multiple sources (Lim et al., 2024). Records from OpenAlex, Crossref validation, and local-source supplementation were merged into one working dataset. DOI fields were normalised, titles were cleaned for matching, and source, author, institution, and country-code fields were standardised where possible. Common variants of Maldives-based institution names were harmonised.

Identification and removal of duplicate records was conducted in stages. DOI matches and OpenAlex work identifiers were checked first, followed by exact title and year matches, title plus first-author matches, and fuzzy title matching. A final duplicate-resolution pass removed high-confidence exact-title duplicates, versioned records, repository copies, and repeated metadata records. Retention favoured published journal records, complete metadata, DOI availability, citation visibility, and non-repository source status. Near-duplicate pairs that could represent distinct versions, chapters, or volumes were retained for manual review.

Because OpenAlex country-code affiliation signals can be noisy, Maldives affiliation was validated after retrieval. A record was counted as validated Maldives-affiliated only when affiliation metadata contained explicit Maldives institutional evidence or when generic agency names were supported by Maldives-specific textual evidence. Records about the Maldives were not counted as Maldives-affiliated unless this institutional evidence was present.

Research-Ecosystem Classification and Indicators

The classification framework separated five forms of Maldives-related research output. Maldives-affiliated research output referred to outputs with a validated Maldives-based institutional affiliation, whereas Maldives-focused research output referred to outputs in which the Maldives was the topic, case, study site, population, ecosystem, economy, or policy object. Within the focused set, locally led research referred to outputs with a Maldives-based first or corresponding author, and where corresponding-author metadata were unavailable the first-author affiliation was used as the leadership proxy. Internationally co-produced research output referred to validated Maldives-affiliated outputs involving at least one foreign institution. Research with no validated local authorship referred to Maldives-focused outputs with no validated Maldives-based author, while externally led research, in the strict sense, referred to the smaller group of Maldives-focused outputs that had a Maldives-based author but a non-Maldives-based first or corresponding author.

Output indicators included annual publication count, period-level output, document type, publication source, local-source contribution, DOI availability, abstract availability, and field distribution. Visibility indicators included citation count, open-access status, and top-cited records. Citation indicators were interpreted as visibility measures, not quality measures, because citation accumulation varies by field, publication age, source type, database coverage, language, and access status.

Authorship indicators were calculated from validated affiliation metadata. The Local Participation Rate was the proportion of Maldives-focused records with at least one validated Maldives-based author. The Local Leadership Rate was the proportion of Maldives-focused records with a Maldives-based first or corresponding author. The Share with No Validated Local Authorship was the proportion of Maldives-focused records with no validated Maldives-based author. The International Co-production Rate was the proportion of validated Maldives-affiliated records involving at least one foreign institution. Country and institutional results were reported as affiliation occurrences and not unique publication counts because a single record may include multiple countries or institutions.

Thematic, SDG, and Policy-Alignment Analysis

Each included record was assigned to one primary thematic field and, where justified, secondary fields. The taxonomy included climate and environment, health and wellbeing, education, tourism and economy, fisheries and ocean, governance and law, technology and digital systems, culture and society, infrastructure, and built environment, and multidisciplinary or other work. OpenAlex topics and concepts provided the first

classification layer, followed by validation using titles, abstracts, keywords, and source information.

SDG mapping used three layers. The first used OpenAlex SDG tags, which are assigned using the Aurora Universities SDG Classifier applied to title and abstract text with adjusted thresholds (OpenAlex, n.d.-b). The second used an SDG keyword dictionary informed by SDG language, Aurora classifier resources, and SDG search-query logic (Aurora Network Global, n.d.; Aurora Universities Network, n.d.). The third involved manual validation for ambiguous, multi-SDG, and high-policy-relevance records. Policy alignment was assessed by comparing thematic and SDG distributions with a policy-priority corpus covering Maldives' VNR 2023, UNDP SDG materials, World Bank climate and development analysis, national statistics, and sector documents on health, education, fisheries, tourism, climate, digital development, and governance. Areas with low research visibility and high policy relevance were treated as potential SDG evidence gaps.

Reproducibility,Quality Control, and Limitations

Reproducibility was supported through raw data archiving, a search log, documented cleaning rules, duplicate-resolution reports, validation flags, and supplementary files. Quality control included Crossref validation of DOI-bearing records, manual inspection of top-cited records, review of externally led records, validation of Maldives-based affiliations, duplicate-resolution auditing, local-source supplementation checks, and sensitivity checks using broader and stricter focus criteria.

The study has limitations. OpenAlex may underrepresent local journals, non-indexed outputs, theses, policy reports, and records with incomplete metadata, and its coverage differs from that of established citation databases (Culbert et al., 2025). Local-source supplementation reduced this limitation but could not guarantee complete coverage. Affiliation metadata were incomplete or noisy in some records, so validated affiliation rules may still miss legitimate Maldives-based affiliations where institution names were absent or ambiguous. Corresponding-author metadata were not always available, so local leadership may be underestimated. SDG classification and policy alignment involved judgement, especially for interdisciplinary records and records without abstracts. These limitations were addressed through transparent coding, validation, sensitivity checks, and cautious interpretation.

RESULTS

Data Construction, Validation, and Duplicate Resolution

The final dataset was constructed from OpenAlex records, Crossref validation, and local-source supplementation from recognised Maldives-based scholarly outlets. Figure 1 summarises the dataset construction, validation, and final analytical sample. After duplicate resolution, the dataset contained 5,834 records within the study period. Of these, 2,645 records met the validated inclusion criteria and 3,189 records were excluded because they were not validated as Maldives-affiliated, Maldives-focused, or derived from a recognised Maldives-based scholarly outlet.

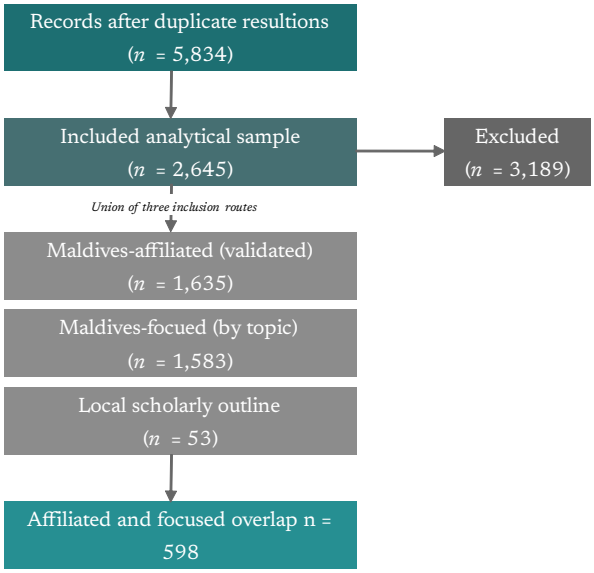


Figure 1. Dataset construction, validation, and final analytical sample

Duplicate resolution removed 154 records from 142 exact duplicate groups. These were mainly versioned records, preprints, repository copies, or repeated metadata records with identical normalised titles. Seven near-duplicate pairs were retained for manual review and not removed automatically because they included potentially distinct volumes, chapters, or versioned scholarly outputs. Table 1 presents the final dataset construction and validation summary.

Table 1. Dataset construction, validation, and final analytical sample

Component	Count
Records after duplicate cleaning	5,834
Included analytical records	2,645
Excluded records	3,189
Exact duplicate groups resolved	142
Automatically removed duplicate records	154
Manual near-duplicate candidate pairs retained	7
Local scholarly outlet records included	53

The validation pass reduced potential affiliation noise by requiring explicit Maldives institutional evidence instead of accepting country-code signals alone. The final analytical dataset included 1,635 validated Maldives-affiliated records and 1,583 validated Maldives-focused records.

A record entered the analytical sample through any one of three inclusion routes, so the sample is the union of these routes and not a single population. Of the 2,645 included records, 1,635 carried a validated Maldives institutional affiliation, 1,583 were Maldives-focused by topic, and 53 were drawn from a recognised Maldives-based scholarly outlet. A total of 598 records satisfied both the affiliation and the focus route, and no included record fell outside all three. The authorship indicators are therefore reported over their proper denominators. Local participation, local leadership and the share with no validated local authorship are calculated over the Maldives-focused set of 1,583 records, while the international co-production rate is calculated over the Maldives-affiliated set of 1,635 records.

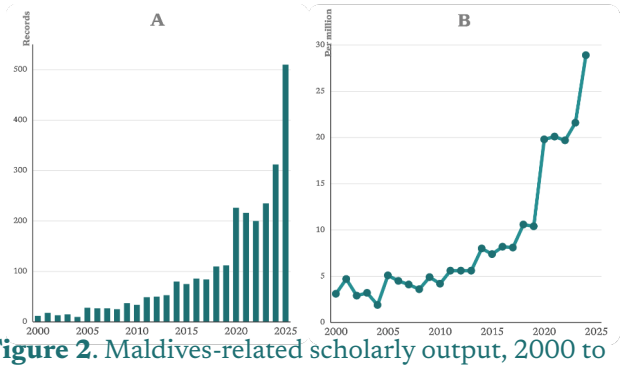


Figure 2. Maldives-related scholarly output, 2000 to 2025. (A) Annual number of records. (B) Output per million works indexed in OpenAlex each year, shown for 2000 to 2024, with the partial 2025 year excluded from the normalisation

The period-level distribution in Table 2 shows that the most recent five-year period accounted for the majority of included records. The earliest decade, from 2000 to 2009, accounted for 212 records, or 8.0% of the final analytical sample. Output increased to 341 records from 2010 to 2015, then to 618 records from 2016 to 2020. The largest increase occurred from 2021 to 2025, when 1,473 records were produced, representing 55.7% of all included records.

Table 2. Publication output by period

Period	Records	Share
2000 to 2009	212	8.0%
2010 to 2015	341	12.9%
2016 to 2020	618	23.4%
2021 to 2025	1,473	55.7%
Period not recorded	1	0.0%
Total	2,645	100.0%

This pattern indicates that Maldives-related research output is heavily concentrated in the most recent period. The results therefore suggest rapid growth in research visibility, although the authorship and leadership findings below show that this growth has not translated into proportional local leadership.

The rise in output survives normalisation against the growth of the indexed literature. Expressed as Maldives-related works per million works indexed in OpenAlex each year, output rose from about 3.8 in the 2000s to about 22.6 in 2021 to 2024, an increase of roughly sixfold in relative terms, while the global indexed corpus was flat to declining across the later years. The expansion is therefore a real gain in national research output and not an artefact of database growth. The most recent year, 2025, was excluded from the normalisation because global index coverage for the newest years is still stabilising, which makes the current-year ratio unreliable. The normalised trend is shown in Figure 2.

Table 3. Publication type, access profile, and local-source contribution (n = 2,645 records)

Period	Records	Share
(a) Publication type		
Article	2,015	76.2%
Book chapter	211	8.0%
Review	94	3.6%
Dissertation	75	2.8%
Unknown	53	2.0%
Preprint	39	1.5%
Book	38	1.4%
Dataset	23	0.9%
Other	23	0.9%
(b) Open-access status		
Closed	1,067	40.3%
Diamond	539	20.4%
Gold	374	14.1%
Green	285	10.8%
Hybrid	212	8.0%
Bronze	115	4.3%
Unknown	53	2.0%
(c) Source dataset		
OpenAlex	2,592	98.0%
Local source	53	2.0%
(d) Local scholarly outlet		
Maldives National Journal of Research	41	1.6%
International Journal of Social Research and Innovation	12	0.5%

The open-access profile was mixed. Closed records formed the largest access category, with 1,067 records, or 40.3% of the sample. Diamond, gold, green, hybrid, and bronze open-access records collectively represented a

substantial share of the dataset, but closed access remained the single largest category. Local-source supplementation contributed 53 records, including 41 records from the Maldives National Journal of Research and 12 records from the International Journal of Social Research and Innovation. These local-source records represented a small share of the final dataset but were methodologically important because they reduced the risk of undercounting locally published research output.

Authorship Geography, Local Participation, and Local Leadership

The strongest research-ecosystem finding concerns authorship geography. The final validated dataset contained 1,583 Maldives-focused records. Of these, 598 records included at least one Maldives-based author, giving a validated local participation rate of 37.8%. Only 319 Maldives-focused records were locally led, corresponding to a validated local leadership rate of 20.2%. By contrast, 985 Maldives-focused records had no validated Maldives-based author and were classified as having no validated local authorship, giving a share of 62.2%. Figure 3 visualises this authorship typology.

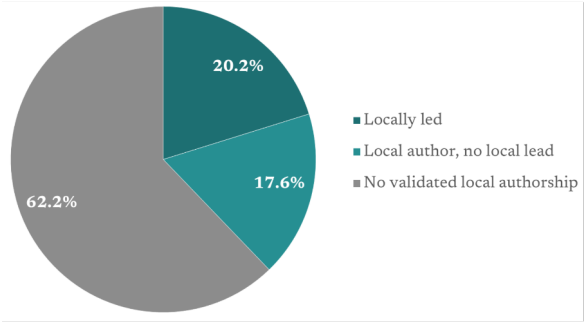


Figure 3. Authorship typology of Maldives-focused research (n = 1,583)

Table 4 reports the validated authorship geography and leadership indicators. Among the 1,635 validated Maldives-affiliated records, 1,214 involved at least one foreign institutional affiliation, producing an international co-production rate of 74.3% among Maldives-affiliated records.

The authorship typology shows a clear imbalance. Of the Maldives-focused evidence base, about one-fifth was locally led, while nearly two-thirds had no validated local authorship. A further 279 records have a Maldives-based author but no Maldivian lead. These records, not the no-authorship category, are the externally led records in the strict sense, and they indicate participation without lead authorship. This distinction matters because a study can include a Maldives-based author without that author shaping its research questions, design, interpretation, or agenda.

Table 4. Validated authorship geography and leadrship indicators

Indicator	Count or percentage
Validated Maldives-affiliated records	1,635
Validated Maldives-focused records	1,583
Maldives-focused records with Maldives-based author	598
Maldives-focused locally led records	319
Maldives-focused records with no validated local authorship	985
Internationally co-produced among Maldives-affiliated records	1,214
Local Participation Rate	37.8%
Local Leadership Rate	20.2%
Share with no validated local authorship	62.2%
International Co-production Rate	74.3%

Local leadership does not depend on the choice of proxy. Under three definitions the rate is stable, at 20.2% by validated locally led records, 20.3% by a Maldives-based first author, and 19.0% by a Maldives-based corresponding author. Corresponding-author country is missing for about a quarter of records, so that proxy is a lower bound, and the first-author proxy is used as the primary indicator. Because author-order conventions differ across health, marine science, education and the social sciences, the leadership rate for any single field should be read with that variation in mind.

Thematic Field Distribution

The field distribution was highly uneven. Figure 4 shows that climate and environment was the largest field, with 897 records, representing 33.9% of the analytical sample. Health and wellbeing followed with 780 records, or 29.5%. Fisheries and ocean research formed the third-largest field, with 350 records, or 13.2%, once marine-biology and fisheries records were separated from the climate category during coding validation. Together, climate and health accounted for just under two-thirds of the validated dataset, about 63%.

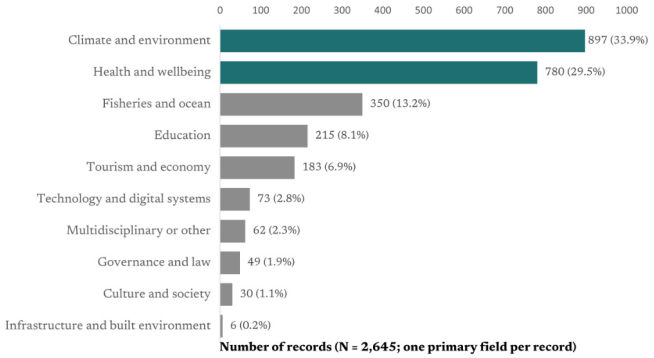


Figure 4. Field distribution of validated Maldives-related research

Table 5 gives the full field distribution. Fisheries and ocean accounted for 350 records and education for 215 records, followed by tourism and economy with 183 records. Technology and digital systems, multidisciplinary or other, governance and law, culture and society, and infrastructure and built environment were smaller categories.

Table 5. Thematic field distribution (n = 2,645 records, one primary field per record)

Field	Records	Share
Climate and environment	897	33.9%
Health and wellbeing	780	29.5%
Education	215	8.1%
Tourism and economy	183	6.9%
Technology and digital systems	73	2.8%
Multidisciplinary or other	62	2.3%
Fisheries and ocean	350	13.2%
Governance and law	49	1.9%
Culture and society	30	1.1%
Infrastructure and built environment	6	0.2%
Total	2,645	100.0%

The distribution shows a strong environmental and health orientation. This is consistent with the Maldives' exposure to climate, coral reef, marine, and public health challenges. However, the relatively small counts for governance, infrastructure, culture, social domains, and digital systems suggest that some policy-relevant areas remain less visible within the indexed and locally supplemented evidence base. For infrastructure and built environment in particular, the near-absence of only six records persists after the coding-boundary correction, so it is read as a genuine evidence gap and not a classification artefact.

SDG Distribution and Evidence-Gap

SDG tagging produced a development-oriented profile of the dataset.

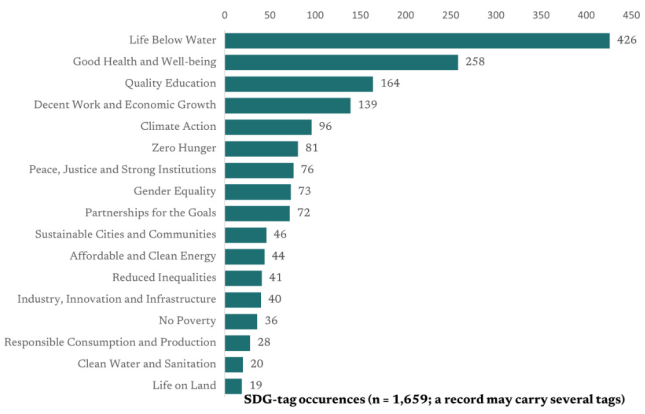


Figure 5. Leading SDG tag occurences in Maldives=related research

The SDG counts represent tag occurrences, not unique publications, because a single record can contribute to more than one SDG. Figure 5 shows that the most frequent SDG tag was Life Below Water, with 426 occurrences, followed by Good Health and Well-being with 258 occurrences and Quality Education with 164 occurrences.

Table 6 presents the full SDG distribution. Other visible SDG areas included Decent Work and Economic Growth, Climate Action, Zero Hunger, Peace, Justice and Strong Institutions, Gender Equality, Partnerships for the Goals, Sustainable Cities and Communities, Affordable and Clean Energy, and Reduced Inequalities.

Table 6. SDG distribution (SDG-tag occurences, not records; total occurrences = 1,659, becuase a record may carry several tags and untagged records are excluded

SDG	Tag occurrences
Life Below Water	426
Good Health and Well-being	258
Quality Education	164
Decent Work and Economic Growth	139
Climate Action	96
Zero Hunger	81
Peace, Justice, and Strong Institutions	76
Gender Equality	73
Partnerships for the Goals	72
Sustainable Cities and Communities	46
Affordable and Clean Energy	44
Reduced Inequalities	41
Industry, Innovation, and Infrastructure	40
No Poverty	36
Responsible Consumption and Production	28
Clean Water and Sanitation	20
Life on Land	19

The SDG distribution confirms the dominance of marine, health, education, labour, and climate-related research. At the same time, several policy-relevant SDGs appear less visible, including Clean Water and Sanitation, Responsible Consumption and Production, Industry, Innovation and Infrastructure, Reduced Inequalities, and Sustainable Cities and Communities. These lower-frequency SDG areas should be interpreted as potential evidence gaps only when considered alongside Maldives policy-priority documents, because SDG tag counts alone measure research visibility and not policy need.

This reading carries a degree of circularity that should be stated plainly. The policy-priority corpus used to judge which areas are evidence gaps partly reflects, and is produced from, the same visible international literature that the study maps, so the evidence-gap interpretation is not

drawn from two fully independent sources of ground truth.

A policy-alignment reading of the distribution suggests four broad categories. Life Below Water, health, education, Climate Action, and decent work appear as visible research areas with clear policy relevance. Infrastructure, clean water, sustainable cities, governance, inequality, and consumption-related themes appear less visible relative to their development importance. These areas should therefore be treated as priority candidates for future targeted evidence synthesis and national research planning.

Citation Visibility and Highly Cited Maldives-Focused Records

Citation counts were used as visibility indicators, not as measures of research quality. The unfiltered top-cited list contained several broad global or regional studies. For the main Results, Table 7 therefore reports a stricter visibility profile that retained only records classified as validated Maldives-focused and excluded records flagged as broader global, regional, or multi-country studies.

Table 7. Top cited strongly Maldives-focused records

Rank	Title	Year	Source	Citations	Field
1	Anthropogenic Marine Debris assessment with Unmanned Aerial Vehicle imagery and deep learning	2019	The Science of The Total Environment	175	Climate and environment
2	Microplastic and charred microplastic in the Faafu Atoll, Maldives	2018	Marine Pollution Bulletin	164	Climate and environment
3	Bleaching Damage and Recovery Potential of Maldivian Coral Reefs	2000	Marine Pollution Bulletin	150	Climate and environment
4	Assessment of Residential Satisfaction with Public Housing in Hulhumalé, Maldives	2012	Procedia Social and Behavioral Sciences	142	Climate and environment
5	Coral Bleaching and Mortality on Artificial and Natural Reefs in Maldives in 1998	2001	Marine Pollution Bulletin	133	Climate and environment
6	Geological effects of tsunami on mid-ocean atoll islands	2006	Geology	132	Climate and environment
7	Doing good to be green and live clean	2022	Journal of Cleaner Production	130	Climate and environment
8	Microplastics as a threat to coral reef environments	2019	Marine Pollution Bulletin	123	Climate and environment
9	From monsoons to mantas	2011	Fisheries Oceanography	117	Climate and environment
10	A Decade After the 2004 Indian Ocean Tsunami	2015	Pure and Applied Geophysics	111	Climate and environment

The most cited strongly Maldives-focused records were concentrated in climate, environment, marine debris, coral reefs, coastal geomorphology, energy systems, and public housing. The highest-cited record in this filtered set examined anthropogenic marine debris using unmanned aerial vehicle imagery and deep learning along the beaches of the Maldives, with 175 citations. Other highly visible records addressed microplastics in Faafu Atoll, coral bleaching, residential satisfaction in Hulhumalé, tsunami effects on atoll islands, manta ray distribution, reef growth, and renewable island energy systems.

The filtered citation profile reinforces the field-distribution result. The most visible Maldives-focused research is dominated by climate, coastal, marine, coral reef, and environmental themes. Social, governance, education, and health records were less prominent among the most cited Maldives-focused publications.

Sensitivity and Robustness Checks

The validation and cleaning steps did not alter the central authorship finding. After duplicate resolution and validated classification, the local participation rate was 37.8%, the local leadership rate was 20.2%, and the share with no validated local authorship was 62.2%. These values remained close to the first-pass estimates, which reported local participation at 38.5%, local leadership at 20.4%, and external authorship at 61.5%.

Duplicate resolution removed 154 records, equal to about 2.6% of the pre-cleaning dataset. The near-duplicate file contained seven candidate pairs, but these were retained because they included potentially distinct volumes, chapters, preprint or article variants, or records requiring manual judgement. Local-source supplementation added 53 local scholarly outlet records. This addition improved coverage of local scholarly outputs but did not materially change the overall authorship pattern.

A separate focus-review flag identified 211 records that mention the Maldives but may represent broader regional, global, or multi-country studies. These records were retained in the main validated dataset because they contain Maldives-relevant evidence, but sensitivity interpretation should acknowledge that some are not exclusively Maldives-centred. The central conclusion remains stable despite this caveat.

The automated classification was validated against

manual coding of a stratified sample of 150 records. Agreement for the single-label thematic field was fair (Cohen's kappa = 0.39), and agreement for the multi-label SDG assignment was moderate at the tag level (micro kappa = 0.54, mean Jaccard = 0.51), with well-populated tags such as Life Below Water and Quality Education agreeing strongly and sparse tags agreeing weakly. The validation identified a systematic boundary between the climate and the marine or fisheries categories, which was corrected before the thematic distribution was finalised, and it showed that 38% of included records carried no SDG tag, so the SDG counts are read as indicative of research visibility and not as a precise measure of development relevance, consistent with evidence that independent SDG-classification approaches can yield divergent results (Armitage et al., 2020).

Overall, the validated results show that the Maldives-related research ecosystem has expanded substantially, especially after 2020. However, the evidence base remains concentrated in climate, environment, and health, while Maldives-focused research is still more often externally led than locally led. This pattern indicates that growth in research visibility has not yet translated into equivalent local leadership across the Maldives-focused evidence base.

DISCUSSION

This study mapped Maldives-related research output as a national research ecosystem and not as a simple publication count. The findings show a rapidly expanding but uneven evidence base. More than half of the validated records were published between 2021 and 2025, indicating a recent acceleration in the visibility of Maldives-related research. The strongest thematic concentrations were climate, environment, health, and wellbeing, which together accounted for about 63% of the dataset. This pattern is consistent with the Maldives' exposure to climate-sensitive marine systems, coral reef dependence, public health pressures, and development risks. The World Bank Group (2024) similarly identifies tourism, fisheries, natural capital, and climate resilience as central to the country's development trajectory.

The most important finding concerns authorship geography. Among Maldives-focused records, only 37.8% included a Maldives-based author, and only 20.2% were locally led. By contrast, 62.2% had no validated local authorship. These findings show that research visibility and research leadership are not equivalent. The Maldives is increasingly visible in scholarly literature, but much of the country-focused evidence base is still produced without validated Maldives-based authorship. This distinction shifts the assessment of national research systems from how much is published to who participates, who leads, and where interpretive authority is located.

This visibility-versus-leadership distinction is the study's central contribution. Counting research output as a single quantity conflates being studied with leading the study, and separating the two converts a simple publication count into a measure of who holds interpretive authority over a country's evidence base. The distinction is portable to other small research systems, where visibility and leadership are likely to diverge in the same way, so the value of the analysis lies less in the Maldives totals than in the question it makes answerable.

Growth in Visibility Without Proportional Local Leadership

The temporal pattern indicates a growing research ecosystem, but publication growth should not be interpreted automatically as domestic research-system strengthening. Increased output may reflect expanding global interest in small island climate vulnerability, stronger international collaboration, improved metadata coverage, growth in open bibliographic infrastructures, and rising research activity by Maldives-based institutions. These are positive signals, but the local participation and leadership rates show that visibility has expanded faster than validated local leadership.

This distinction matters because a country may be frequently studied while having limited influence over research questions, methods, interpretation, and policy translation. Recent bibliometric guidance cautions that mapping studies have limited value when they stop at descriptive publication counts without explaining implications for theory, policy, or practice (Hulland, 2024; Mukherjee et al., 2022). In this study, Maldives-related research visibility should therefore be read as evidence of growing scholarly attention, not automatically as evidence of domestic research capacity. Research-system strengthening requires stronger local authorship, institutional anchoring, first-author or corresponding-author leadership, data access, and uptake into national decision-making.

International Co-production and Asymmetric Knowledge Leadership

The findings show a highly internationalised research ecosystem. Among validated Maldives-affiliated records, 74.3% involved at least one foreign institutional affiliation. International co-production can be beneficial, especially for small research systems that need access to specialised methods, comparative datasets, technical infrastructure, and global publication networks. In climate,

marine, reef, disaster, and health research, international collaboration may be necessary because scientific questions often require long-term monitoring, multi-site data, and specialised analytical capacity.

Whether this level of internationalisation is unusual is best judged against comparable settings. High international co-production alongside modest local first-authorship is a recognised feature of collaboration between countries of differing development levels, where authorship order and corresponding-author roles often favour partners from higher-income settings (González-Alcaide et al., 2017). The Maldives figures of about one-fifth local leadership and about three-quarters international co-production therefore sit within a recognisable pattern for small and lower-resourced research systems instead of being anomalous.

The concern is not collaboration itself, but asymmetric knowledge leadership. Maldives-focused records fell into three categories: locally led studies, studies with Maldives-based participation but external leadership, and studies about the Maldives without validated Maldives-based authorship. These forms of participation are not equivalent. Local participation without leadership may improve inclusion, but it does not necessarily indicate local agenda-setting power.

Externally led research is not inherently problematic. It can provide technical depth, comparative insight, and international visibility. However, when externally led work dominates a country-focused evidence base, it raises questions about research ownership, interpretive authority, and equitable collaboration. Haelewaters et al. (2021) caution against research practices that treat local actors mainly as data providers or logistical facilitators. Dutta et al. (2023) describe equitable research partnerships around mutual participation, trust, respect, and shared benefit. McIntosh et al. (2023) similarly argue that leadership of global health research should sit with academics, clinicians, and communities in the locations being studied, a position echoed by the Nature Geoscience (2022) editorial calling for an end to helicopter research. The Maldives pattern also fits wider concerns about Global South representation in global knowledge production (Longley & Bandara, 2025; Rucavado Rojas & Postigo, 2025). The practical objective is not to reduce collaboration, but to ensure that collaboration strengthens local leadership, institutional learning, and policy-relevant evidence capacity.

A question that follows from the authorship pattern is whether locally led work is heard as well as counted. Maldives-led records were markedly more likely to be openly accessible than records with no validated local authorship (67.7% against 48.8%, chi-square $p < 0.001$), yet they attracted fewer citations (Mann-Whitney U, $p = 0.017$, with means of 6.9 against 10.8 and a median of one citation in both groups). Local leadership therefore coincides with greater openness but not with greater citation uptake, so visibility in the record does not translate directly into scholarly influence.

Thematic Concentration and SDG Evidence Gaps

The concentration in climate, environment, and health is understandable. Small island developing states face intense climate pressures, and the Maldives is especially exposed through coral reefs, tourism, fisheries, coastal infrastructure, and public health risks. Thomas and Theokritoff (2024) show that SIDS report multiple adaptation constraints, with finance as a major constraint and governance as an important enabling condition. Gordon-Strachan et al. (2025) further show that SIDS face climate-health risks across heat, food security, infectious disease, health systems, adaptation capacity, and economic vulnerability. These studies support the strong visibility of climate, marine, and health-related research in the Maldives dataset.

Yet the concentration also points to imbalance. Governance and law, infrastructure and built environment, digital systems, inequality, water and sanitation, social protection, and urban resilience were less visible. These are not marginal policy areas. Jansson et al. (2025) argue that urbanisation remains underrepresented in SIDS climate strategies despite the climate vulnerability of island cities. Hambleton and Jeyaseelan (2024) also show that SIDS face marked data-availability and statistical-capacity constraints, which can limit development monitoring. These findings support the interpretation that low visibility in some SDG areas may reflect evidence-system gaps and not low policy relevance.

The SDG pattern should therefore be read cautiously. SDG tag counts measure research visibility, not national need. The high visibility of Life Below Water, health, education, decent work, and Climate Action is consistent with the Maldives' global and national profile. However, lower visibility for clean water and sanitation; infrastructure; reduced inequalities; sustainable cities; and responsible consumption suggests areas where targeted evidence generation may be needed. This interpretation is strengthened when the bibliometric pattern is compared with Maldives policy priorities in the Voluntary National Review and UNDP SDG materials, which link national development to resilience, wellbeing, connectivity, gender equality, climate action, and sustainable urban systems (Government of Maldives, 2023; United Nations Development Programme, 2024).

Read as priorities, these gaps point to specific lines of work and not to a general call for more research. Low vis-

ibility in Clean Water and Sanitation invites a targeted synthesis of island water security and sanitation under dispersed-atoll conditions. The near-absence of infrastructure and built-environment research argues for commissioned studies of housing, coastal protection, and inter-island connectivity aligned with national resilience priorities. Weak coverage of Reduced Inequalities calls for disaggregated analysis of atoll-level disparities in services and income. Limited work on Sustainable Cities and Communities supports research on island urbanisation and the resilience of a fast-growing capital, consistent with the underrepresentation of urbanisation in small island climate strategies (Jansson et al., 2025). Thin governance and law coverage points to research on decentralisation and institutional reform, which the Voluntary National Review identifies as a national priority (Government of Maldives, 2023), and the small technology and digital-systems literature invites work on digital governance and connectivity across a dispersed population. Pairing each gap with a concrete line of work makes the evidence map directly usable for national research planning.

Local journals, Visibility, and National Research Infrastructure

Local-source supplementation added 53 local scholarly outlet records, mainly from the Maldives National Journal of Research and the International Journal of Social Research and Innovation. Quantitatively, this was a small share of the analytical sample. Methodologically, it was important because national scholarly ecosystems are not fully captured by international bibliographic databases. Local journals may publish applied, practitioner-oriented, education-focused, policy-relevant, or early-career research that is less visible in global metadata systems.

These observations describe what the 53 local-outlet records actually contain. Broader statements about the domestic publishing sector are offered as informed inference from the local research context and not as claims derived from this small subset alone.

The local-journal finding should therefore be interpreted as an infrastructure signal. Local outlets can support domestic authorship, create publication pathways for national researchers, and document policy-facing research output. Their contribution depends partly on metadata quality. DOI assignment, structured abstracts, consistent keywords, ORCID use, standardised institutional affiliations, and reliable indexing practices can improve discoverability. UNESCO's Recommendation on Open Science emphasises open, transparent, inclusive, and collaborative scientific practices and recognises the importance of reducing inequalities in access to scientific knowledge (UNESCO, 2021). For Maldives-based journals, stronger metadata and open access are therefore part of research infrastructure, not only editorial administration.

The national research funding environment also matters. Public Service Media (2024) reported the establishment of a National Research Fund, while Maldives National University (n.d.) describes the National Research Fund Emerging Research Grants as supported by the National Research Council. These developments indicate emerging institutional support for research capacity. The findings of this study suggest that such mechanisms should support not only more publications, but locally led, policy-aligned, and discoverable research in underrepresented areas.

Implications for Policy, Universities, Journals, Collaborators, and Funders

The findings have direct implications for research policy. National research planning should track not only how much Maldives-related research is produced, but who leads it, which institutions participate, what fields dominate, and which SDG areas remain weakly evidenced. A national research observatory or repository could maintain an updated map of Maldives-affiliated and Maldives-focused outputs, including local journals, theses, reports, and institutional publications.

Universities and research institutions should treat local leadership as a strategic outcome. The low local leadership rate suggests a need for stronger support for first-author and corresponding-author leadership by Maldives-based researchers through postgraduate publication training, grant-writing support, methods training, research mentorship, and incentives for interdisciplinary work in governance, infrastructure, digital systems, water and sanitation, education quality, and social development. Local journals can strengthen the national research ecosystem by improving metadata quality and indexing readiness. International collaborators should design Maldives-focused projects around equitable partnership principles, involving Maldives-based researchers from problem definition through analysis, authorship, dissemination, and policy translation. The Alliance of Small Island States (2022) makes a similar point for SIDS marine science capacity by emphasising SIDS-defined needs and a move away from one-way capacity initiatives. Development partners and funders should support capacity-strengthening models that are tailored, focused, and locally grounded, as recommended by the Organisation for Economic Co-operation and Development (2024). The United Nations Department of Economic and Social

Affairs (2024) also identifies science, technology, and innovation as opportunities for SIDS development. For the Maldives, research funding should therefore prioritise locally led evidence generation, equitable partnerships, data infrastructure, and underrepresented policy areas and not publication growth alone.

Strengths and Limitations

This study has several strengths. It used an open and reproducible bibliographic pipeline, combined international metadata with local-source supplementation, validated affiliation and focus categories, resolved high-confidence duplicates, and distinguished Maldives-affiliated, Maldives-focused, locally led, internationally co-produced, and externally led research. This framework allowed the study to move beyond routine bibliometric output counts and examine authorship leadership, thematic concentration, access status, SDG visibility, and research-system structure. It also aligned with responsible research-assessment principles by treating metrics as contextual indicators and not direct measures of quality (Coalition for Advancing Research Assessment, 2022; Hicks et al., 2015).

The study also has limitations. First, the dataset represents visible scholarly output, not a complete census of all knowledge produced in or about the Maldives. OpenAlex may miss local reports, policy documents, theses, non-indexed outputs, and records with incomplete metadata. Local-source supplementation reduced this limitation but could not eliminate it. Second, affiliation metadata were noisy. The study used validated affiliation rules, but some legitimate Maldives-based affiliations may still have been missed when institution names were absent, abbreviated, or poorly indexed. Third, local leadership was estimated through first-author and corresponding-author indicators where available. Corresponding-author metadata were incomplete in some records, so local leadership may be underestimated.

The search was also conducted in English and keyed to the term Maldives and to validated affiliations, which under-captures Dhivehi-language work and records indexed under atoll, island or institution names and not the country name. A spot-check against a hand-curated list of known local outputs recovered most through the affiliation and local-outlet routes, but the English-only strategy remains a recall limitation, so the local-leadership and field shares should be read as lower bounds for genuinely local scholarship.

Fourth, SDG mapping should be interpreted as research visibility, not definitive development relevance. Automated SDG tags are useful for scale, but interdisciplinary records, missing abstracts, and broad policy relevance can produce classification uncertainty. Fifth, citation counts were treated only as visibility indicators because they are influenced by field size, publication age, database coverage, language, access status, and journal visibility. Finally, policy-alignment interpretation depends on the selected policy corpus. These limitations mean that the study should be read as a structured map of visible Maldives-related research output, not as a complete inventory of national knowledge production.

CONCLUSION

This study mapped Maldives-related research output from 2000 to 2025 as a national research ecosystem and not as a simple publication count. By combining international bibliographic metadata, Crossref validation, local-source supplementation, duplicate resolution, and validated authorship classification, the study examined how much research exists, who participates, who leads, where evidence is visible, and how research aligns with national development priorities. The findings show a rapidly expanding but uneven research ecosystem. The final analytical sample contained 2,645 validated records, with 55.7% published from 2021 to 2025. Climate and environment, together with health and wellbeing, dominated the evidence base, while several policy-relevant areas, including governance, infrastructure, digital systems, inequality, water and sanitation, and social development, were less visible. Most importantly, among Maldives-focused records, only 37.8% included a Maldives-based author and only 20.2% were locally led, while 62.2% had no validated local authorship. This indicates that Maldives-related research visibility has increased, but visibility has not yet translated into proportional local leadership.

The study contributes a reproducible framework for assessing research ecosystems in small island states by distinguishing Maldives-affiliated research output from Maldives-focused research output and separating local participation from local leadership. This distinction matters because a country can be visible as a research site while remaining less visible as a research leader. Future work should extend this mapping through comparative studies of other small island states, qualitative research with Maldives-based researchers and policymakers, and analysis of research funding, postgraduate theses, institutional repositories, data-sharing practices, and policy uptake. For the Maldives, the single highest-priority action is to build local research leadership, so that Maldivian researchers more often lead the studies that concern their own country. The remaining measures, equitable international collaboration, stronger local journals, better metadata, open and accessible evidence, and targeted support for underrepresented policy areas, support that

primary goal instead of standing beside it as equal alternatives. Increasing publication output remains important, but it is not sufficient. For small island states, research visibility is valuable, but research leadership is what turns visibility into policy-relevant and institutionally anchored knowledge.

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AUTHOR CONTRIBUTIONS

H.A.S. conceptualised the study, designed the methodology, conducted the bibliographic retrieval and analysis, prepared the figures and tables, and drafted the manuscript. M.M. contributed to Maldives-context interpretation, local-source validation, manuscript review, and critical revision. Both authors reviewed and approved the final manuscript.

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DATA AVAILABILITY

The cleaned metadata, search log, coding rules, and supplementary materials are available from the corresponding author upon reasonable request.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS APPROVAL

Ethics approval was not required because the study used publicly available bibliographic metadata and did not involve human participants, personal data collection, or intervention.

USE OF AI-ASSISTED TOOLS

Generative AI tools were used to support language editing and to assist with reference discovery during manuscript preparation. All data collection, analysis, and interpretation were performed by the authors using the documented and reproducible pipeline. Every reference was checked against its primary source by the authors, who reviewed and take full responsibility for all content, analysis, interpretations, and references.