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Research Article

Assessing Alignment between Collaboration and Disciplinary Profiles: A Core-Periphery Approach Applied to Atmospheric Water Harvesting

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ABSTRACT

The integration of emerging technologies is influenced by differences in national disciplinary expertise and the structure of international scientific collaboration. In peripheral research systems, misalignment between countries' areas of specialization and their collaboration networks may reinforce patterns of scientific dependency. Atmospheric Water Harvesting (AWH) provides a relevant context for examining these relationships within a core–periphery framework. This study aimed to assess the alignment between national disciplinary profiles and international collaboration networks in AWH research, with particular emphasis on peripheral countries. It further sought to determine whether collaboration intensity corresponds to disciplinary proximity and to identify distinct patterns of collaboration–specialization positioning. Publications on AWH from the Web of Science database covering the previous decade were analyzed. A core set of 30 dominant research themes was identified, and national disciplinary profiles were constructed using activity indices across these themes. Disciplinary proximity between countries was quantified using cosine similarity and systematically compared with observed international collaboration patterns to evaluate collaboration–specialization coherence. The analysis was applied to ten peripheral countries within a core–periphery framework. The findings revealed substantial heterogeneity in the alignment between national specializations and collaborations with key core partners. Four distinct positioning models were identified among the peripheral countries. Collaboration intensity was not consistently associated with disciplinary proximity, and several countries maintained international partnerships that were weakly related to their existing specialization profiles. Such mismatches may reduce opportunities for cumulative learning and limit the effective development of existing national capabilities, whereas stronger alignment between specialization and collaboration appeared to provide a more favorable basis for learning and strategic positioning. The study demonstrates that the relationship between scientific specialization and international collaboration is an important dimension of understanding structural patterns in peripheral research systems. By operationalizing collaboration–specialization alignment through a reproducible analytical framework, the study provides a systematic approach for evaluating international research positioning and identifying conditions that may either reinforce or mitigate scientific dependency in emerging technological fields such as AWH.

Keywords Atmospheric Water Harvesting, Core-Periphery, Disciplinary Proximity, Innovation Catch-Up, Knowledge Alignment, Scientific Collaboration.

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INTRODUCTION

Atmospheric Water Harvesting as an Emerging Field of STI Governance

The AWH alternative against water stress

Water scarcity is a global challenge, particularly in regions such as sub-Saharan Africa, the MENA region, and Australia (Lord *et al.*, 2021; Al-Addous *et al.*, 2024). In these regions, identifying alternative water sources is a strategic priority but presents a considerable technical challenge. Atmospheric Water Harvesting

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(AWH) is one such option, especially for areas not served by conventional water supply infrastructure.

Indeed, under certain favorable conditions, AWH solutions can contribute to partial water self-sufficiency in underserved areas (Wang *et al*., 2022; Humphrey *et al*., 2020). In particular, in certain regions where conventional water supply or desalination techniques are not economically viable (Wang *et al*., 2024; Zhang *et al*., 2022), this argues for decentralized alternatives such as AWH.

However, the effective deployment of these solutions depends on the acquisition of appropriate and necessary scientific knowledge. For peripheral countries, this raises a strategic challenge: identifying essential knowledge areas and streamlining international collaboration efforts to better support technology adoption. From this perspective, collaboration is seen as a key lever for technological catch-up.

Technological overview and main research questions

Three major area's structure research on AWH: fog harvesting, active condensation, and adsorption-desorption systems (Ahrestani *et al*., 2023). While fog harvesting is geographically dependent (Sowmya *et al*., 2025) and active condensation is highly energy-intensive (Correia *et al*., 2023), adsorption-based systems are experiencing rapid growth, thanks in particular to advances in materials such as Metal-Organic Frameworks (MOFs) and hygroscopic salts (Zhang *et al*., 2025; Lu *et al*., 2022; Wang *et al*., 2025). These systems thus offer broader prospects, especially in arid environments (Zeng *et al*., 2024a).

However, significant challenges remain. The complexity of heat and mass transfer processes, the intermittency of renewable energy, the durability of materials, and water quality issues lead to persistent performance gaps between laboratory and field applications (Bilal *et al*., 2022;Ehtisham, Saeed-Ul-Hassan and Poater, 2025; Russell *et al*., 2025; Zeng *et al*., 2024b). Furthermore, large-scale implementation remains highly dependent on local socio-technical contexts (Mannai *et al*., 2025; Manyimo *et al*., 2025).

These challenges highlight that the operational diffusion of AWH technologies depends on the appropriation of scientific knowledge by local scientists and technical services. This is also linked to the nature and effectiveness of knowledge and know-how transfers facilitated by scientific collaboration. So, to what extent are developing countries aligning their collaboration strategies with their disciplinary strengths in order to promote effective technological integration?

Collaboration as a strategic lever for peripheral countries

AWH presents a strategic opportunity for countries facing chronic water scarcity (Ibrahim *et al*., 2024). Being on the scientific periphery suggests the need to catch up in terms of knowledge in order to successfully integrate technically and achieve socio-economic benefits.

In this context, international collaboration is a proven mechanism for facilitating knowledge transfer and strengthening expertise (Ebersberger *et al*., 2023; Zhai *et al*., 2025). Its effectiveness can be analytically assessed through the alignment between a peripheral country's disciplinary specialization of that of its main collaborators. Catch-up is especially effective when collaborations involve leading partners, whose disciplinary orientations closely match those of the peripheral country (Alonge *et al*., 2019; Boutracheh and Moumen, 2025; Colther *et al*., 2024).

This reasoning raises key questions: are peripheral countries aware of the benefits of collaborating with leading partners who are thematically aligned? How can their current collaboration-specialization alignment be assessed? And how can these partnerships be better guided and optimized?

Research objectives and analytical contribution

AWH research exhibits heterogeneous engagement, ranging from pilot projects in water-stressed nations (Ait el Kadi *et al*., 2024; Dodson and Bargach, 2015; Ismail and Go, 2021) to experimental programs in European countries (Correia *et al*., 2023; Gustavo Viera Ruiz, 2024; Wang *et al*., 2024). These trajectories reflect diverse environmental and technological contexts where alternative solutions are being explored, particularly in arid and semi-arid regions.

Beyond technological performance, water innovation governance increasingly depends on how scientific capabilities are distributed across countries. Emerging water technologies such as AWH are not only technical solutions but strategic domains shaping future water security. Peripheral positioning within the global knowledge architecture may reinforce scientific dependence and constrain national policy autonomy.

As in many emerging fields, a small group of leaders, notably China, the USA and other countries with mature research infrastructures, dominates the field (Boutracheh *et al*., 2024, 2025). This study positions ten selected peripheral countries (Egypt, Chile, UAE, Belgium, South Africa, Jordan, Qatar, Morocco, Portugal, and Namibia) within this global landscape.

The selection is purposive rather than statistically representative. Countries were retained because they combine sufficient activity in AWH to support meaningful disciplinary profiling with a position outside the empirically identified Core, while representing heterogeneous scientific, geographical, institutional, and socio-environmental contexts. The objective is therefore not to identify all countries facing water-stress challenges, but to compare contrasting peripheral research trajectories within a common AWH knowledge structure.

Methodologically, we assess the coherence between their disciplinary specialization and international collaboration patterns by combining Activity Index (AI) profiling with cosine similarity to measure disciplinary proximity. Linking specialization to collaboration strategies, the study provides an analytical framework for assessing alignment in scientific systems and supporting evidence-based decision-making to accelerate technological catch-up.

Beyond descriptive bibliometrics, this approach captures structural relationships between specialization and collaboration, revealing how global knowledge asymmetries shape differentiated governance capacities and policy autonomy in the water sector.

Data and methodological approach

Using the example of AWH, this section explains the rationale and steps taken to address the issue of coherence between national specialization profiles and international collaboration models. The main contribution lies in combining disciplinary profiling and collaboration analysis within a unified alignment framework, enabling a systematic assessment of coherence between specialization structures and partnership models. After explicitly identifying the core-periphery structure of the field, this approach allows for a comparison of the strategic positioning of several peripheral profiles within the global AWH research landscape and informs reflection from the perspective of STI governance.

The AWH's core-periphery structure

The core-periphery framework makes it possible to characterize leading countries and central themes, in a scientific field, and thus reveal structural asymmetries in terms of contribution and influence (Marginson, 2022; Montaño Ramirez and Petersen, 2026; Sorooshian *et al*., 2024). This makes it possible to position peripheral countries, having a strategic ambition in relation to the field considered (AWH), in this global knowledge structure and, then, to assess the state of international collaboration and the opportunities for technological catch-up.

We adapt this framework to Atmospheric Water Harvesting (AWH) to assess the strategic positioning of peripheral countries relative to the field's dominant structures.

In this study, the notion of "periphery" is used in a domain-specific and relational sense. It does not refer to a country's overall scientific, economic, technological, or institutional level, nor to its geographical position. A country is considered peripheral specifically in relation to the structure of the AWH research field when its contribution remains outside the empirically identified core of leading countries. This definition therefore allows heterogeneous national systems to be compared according to their relative position within the same emerging knowledge domain. A country may consequently be peripheral in AWH research while occupying a much more central position in other scientific or technological fields.

The "core" is empirically defined by ten leading countries (China, USA, India, Germany, South Korea, Japan, England, Canada, Saudi Arabia, and France) that concentrate the majority of scientific output and collaboration.

The thematic structure is captured by the 30 most prolific "Topics," representing the dominant research agenda. These 30 Topics are treated here as an operational representation of the cognitive core of the AWH field. They are not assumed to exhaust the thematic diversity of AWH research; rather, they constitute a parsimonious reference structure because they jointly account for more than 80% of the corpus. This allows the analysis to focus on the dominant cognitive space in which the field's main research orientations and leading contributors are concentrated.

The selected peripheral countries are assumed to seek integration into this core structure. Their challenge is to orient research efforts and collaboration to facilitate cumulative learning. To this end, we analyse three complementary dimensions (Figure 1).

- Disciplinary proximity to leading countries (thematic similarity).
- Alignment between international collaboration structures and disciplinary proximities.
- Thematic affinities among peripheral countries (South-South potential).

Measuring disciplinary positioning and proximity

To construct national disciplinary profiles independent of publication volume, we use the Activity Index (AI) (Rousseau and Yang, 2012; Stare and Kejžar, 2014). The AI for "country i" in "topic j" is the ratio between the country's share of global publications in topic j and its share across all 30 topics (FRAME, 1977):

$$\mathbf{AI(i,j)} = \frac{\text{(Publications of country (i) in topic (j) / Global publications in topic (j))}}{\text{(Total publications of country (i) in all 30 topics / Global publications in all 30 topics)}}$$

AI values are normalized by the maximum observed value to yield standardized profiles. Disciplinary Proximity is then assessed using cosine similarity, defined as the dot product between the normalized AI profiles of two countries ($C1$ and $C2$):

$$\mathbf{DP}(C1, C2) = \mathbf{Cosine}(C1, C2) = \frac{\sum_{i=1}^{30}[\, AIi(C1) \times AIi(C2)\,]}{\sqrt[2]{\sum_{i=1}^{30} AIi^2(C1)} \times \sqrt[2]{\sum_{i=1}^{30} AIi^2(C2)}}$$

This metric, widely used in science mapping (Bongioanni *et al*., 2014; Lancho-Barrantes and Cantu-Ortiz, 2021), ranges from 0 (dissimilar) to 1 (perfect alignment). It enables the comparison of specialization structures while neutralizing the influence of extreme values or publication volumes.

The use of cosine similarity is therefore consistent with the analytical objective of identifying relative cognitive proximity,

rather than ranking countries according to scientific size. It allows countries with very different publication volumes to be compared according to the structure of their thematic specialization.

Coherence between collaboration and specialization profile

The strategic coherence of a peripheral country is assessed by comparing its international collaboration model with its disciplinary profile.

For each peripheral country, the aim is to determine whether its collaborations are primarily oriented towards leading countries with which it shares strong disciplinary affinities, or, conversely, whether its collaborative efforts deviate from this logic.

This analysis is complemented by a multi-level thematic focus. Specifically, similarities between each peripheral country and its three closest partners (among Leaders) are examined within the top 6 Topics, accounting for 80% of the global AWH corpus.

In parallel, the three most prolific Topics for each peripheral country are considered to capture national priorities.

As an exploratory visualization tool, radar visualizations synthesize these relationships.

Based on this assessment, the peripheral countries are classified into four categories, derived from observed alignment patterns of collaboration-specialization coherence.

Thus, this typology provides an operational basis for interpreting learning trajectories and catch-up opportunities.

Data sources and methodological boundaries

Data were extracted from the Web of Science Core Collection in November 2025, selected for its standardized metadata and compatibility with topic-level analysis (Bramer *et al.*, 2017; Gusenbauer, 2022; Bornmann and Leydesdorff, 2013b, 2013a).

The query targeted the AWH domain, retaining only peer-reviewed articles, conference papers, reviews, and chapters. The analysis focuses on the 2015-2025 period, which accounts for over 75% of the corpus. The 30 most prolific Topics (out of 341) concentrate over 80% of total publications and constitute the reference framework.

After empirically identifying the core group of leading countries that structure the AWH research landscape, the ten peripheral countries analyzed in this study were selected among active contributors to the AWH literature that remain outside this dominant core group. This approach ensures sufficient publication activity to build meaningful disciplinary profiles, while also allowing for adequate representation of various peripheral research systems.

Nevertheless, certain limitations must be considered in the different interpretations

The analysis captures only the publication-based dimension of international collaboration. Co-publication provides an observable and reproducible indicator of formal scientific interaction, but it does not capture the full range of knowledge-exchange mechanisms, including joint research projects, researcher mobility, patents and co-development, industrial partnerships, technical training, shared infrastructures, or informal knowledge transfer. Consequently, the collaboration patterns identified here

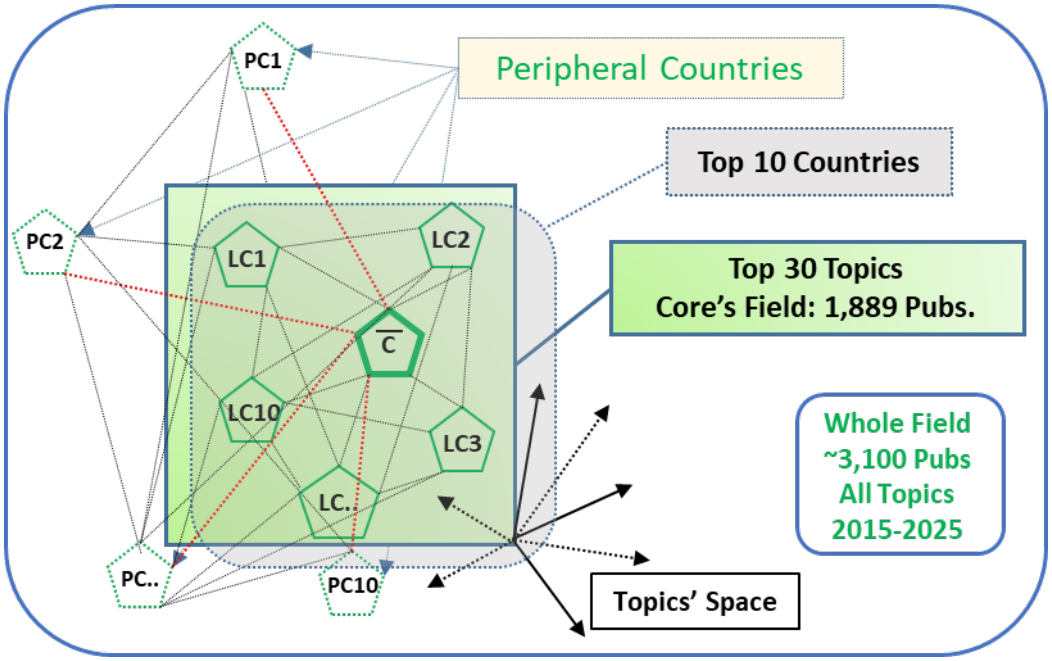


Figure 1: Core and Periphery of the AWH field.

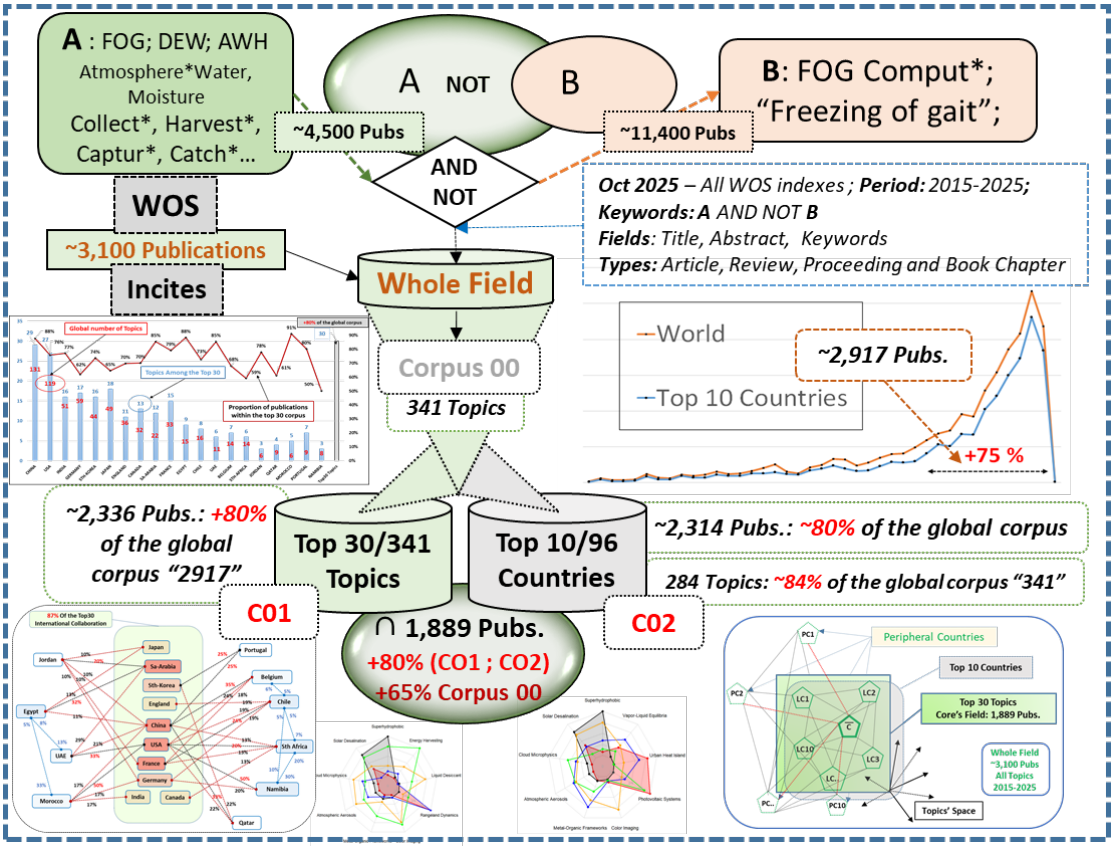


Figure 2: Data and main Steps of the approach.

should not be interpreted as a complete measure of partnership intensity or quality. Rather, they provide a bibliometrically observable representation of international research collaboration that can be complemented by other forms of evidence.

The measure of collaboration considers aggregate co-publication, without going into detail about this relationship (bilateral or multilateral), which is an aspect that deserves in-depth treatment.

The effect of volume is structuring. It was briefly addressed but neutralized to focus on the disciplinary profile.

Thus, these choices serve the prospective objective of the study: to provide a tool for diagnosing strategic positioning and for future reflection.

Figure 2 shows the main steps followed: data extraction, processing, construction of indicators, and their graphical representation.

Structuring Dynamics and Cognitive Positioning in AWH Research

Concentration in the global AWH research

Research on Atmospheric Water Harvesting (AWH) has seen strong growth, with a concentration of more than 75% of publications over the period 2015-2025 (Figure 3).

Furthermore, just ten prolific countries are responsible for almost 80% of the global corpus (China, United States, India, Germany, South Korea, Japan, England, Canada, Saudi Arabia and France). These countries also produce more than 80% of their corpus of publications around the 30 most prolific "Topics" in the field. These 30 Topics reflect, in turn, the dominant thematic orientation of the AWH. These Top 30 Topics form the significant benchmark for the field, which will allow us to assess the relevance of the postures of peripheral countries.

Positioning of peripheral countries: volume vs. impact

Against this benchmark, the ten selected peripheral countries display contrasted positions (Figures 4 and 5). While ranking between 17th and 49th in terms of output, their integration into the core field varies significantly.

Impact Heterogeneity: While leaders generally exhibit high citation impact ((CNCI[1] > 1), peripheral countries show mixed results. Notably, Egypt, Belgium, Qatar, and Morocco achieve impact levels comparable to leading nations, suggesting effective integration into high-visibility research streams despite lower volumes.

1 CNCI: The "Category Normalized Citation Impact" is a metric of citation performance of a set of publications. It normalizes values to account for disciplinary variability and the age of publications. It thus allows for the comparison of bibliometric entities (authors, countries, etc.) and assumes that the expected global reference is "1".

Thematic Selectivity: Most peripheral countries concentrate their output within the Top 30 Topics. However, their participation is uneven: some cover a broad spectrum, while others focus on a limited subset. This combination of concentration and selectivity points to differentiated specialization strategies rather than uniform marginality.

Global disciplinary structure: a material-driven field

The cognitive structure of the field is highly hierarchized (Table 1). Core topics are dominated by materials science (e.g., *Superhydrophobic* surfaces, *MOFs*) and thermodynamics, reflecting the field's experimental foundations. *Superhydrophobic* research accounts for 36.6% of the reference corpus, reflecting the strong materials-science orientation of the field. Beyond this core, secondary clusters emerge around *System Integration* and *Environmental Performance*. These topics, while less central in volume, are strategic for connecting AWH technologies to sustainability agendas. The uneven national participation in these clusters suggests that positioning is shaped not only by scientific capacity but also by strategic choices regarding technological sovereignty.

Disciplinary Proximity (DP) analysis

Using the Activity Index and cosine similarity (methodology detailed in Section 2: see also Appendix A and Appendix B), we

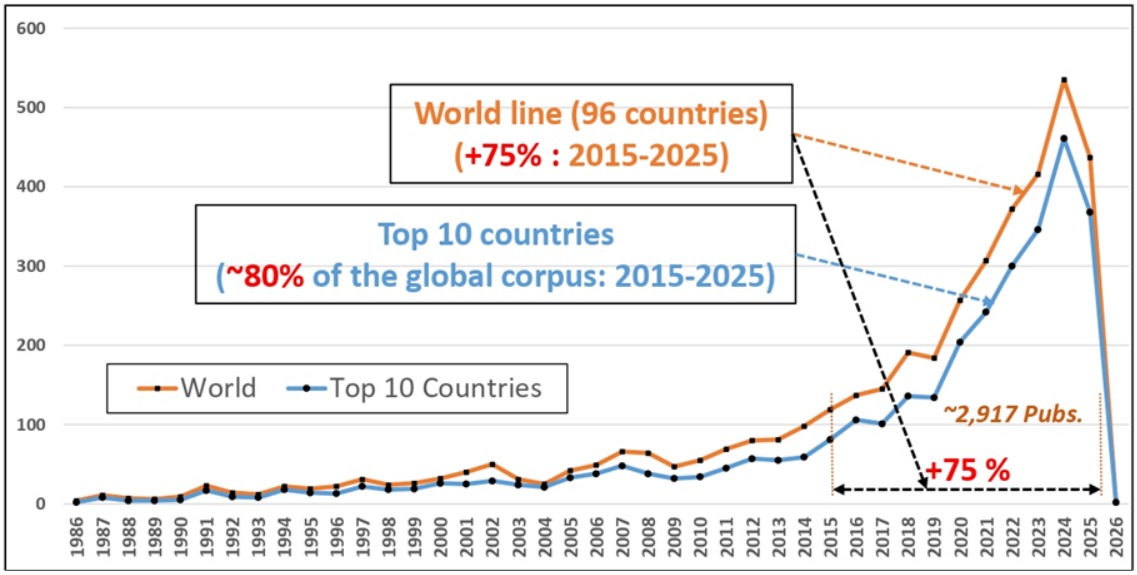


Figure 3: Trend shape and countries' concentration of the AWH field.

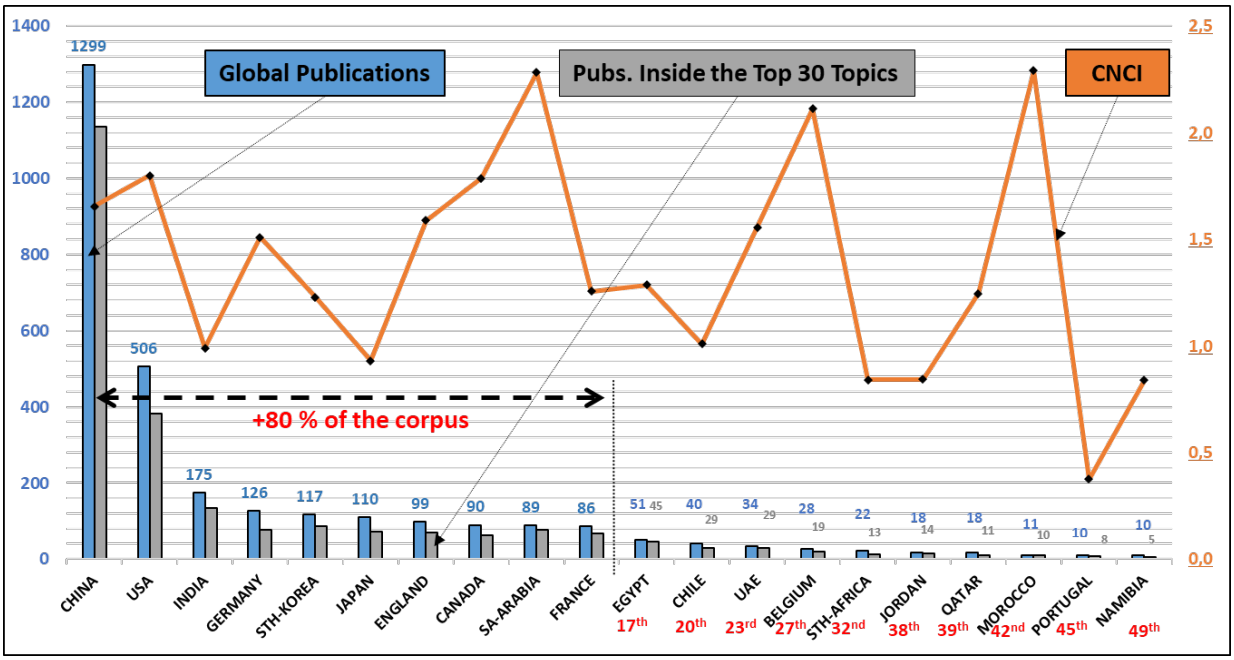


Figure 4: The 20 countries' contributions and impacts within the global and core's AWH field.

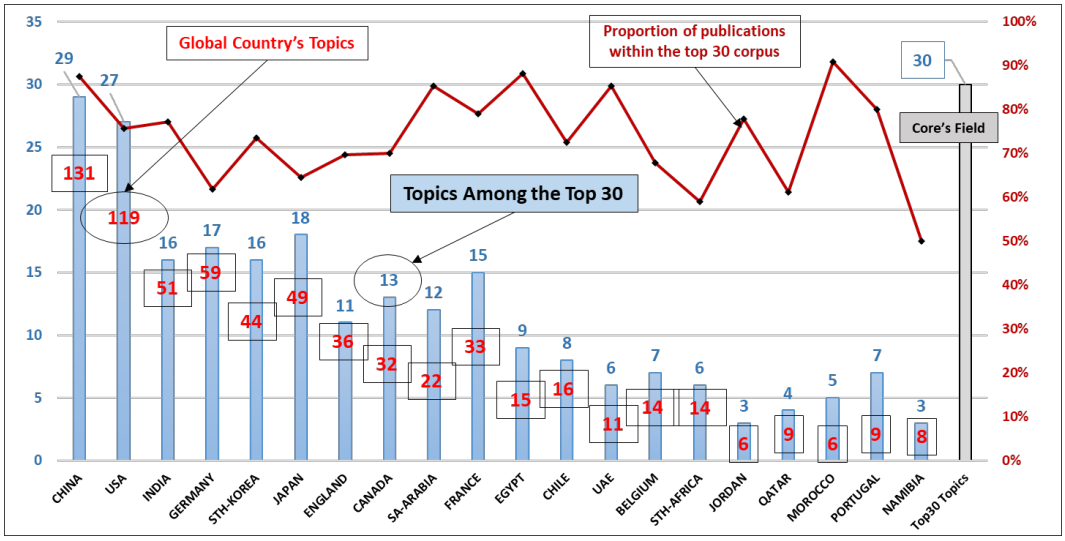


Figure 5: Topics Coverage and contribution proportions of the 20 countries in the AWH field.

assessed the alignment of peripheral countries with the global structure.

Proximity to the global reference profile

The analysis of Disciplinary Proximity (Table 2) reveals that high publication volume does not guarantee alignment with the global average. While China and the USA define the global profile (high cosine), other leaders like Germany display more differentiated orientations. Crucially, several peripheral countries (Egypt, Jordan, and the UAE) exhibit higher proximity to the global profile than some leaders. This confirms that alignment is a function of the *distribution* of thematic efforts, not scale. However, proximity to the global average remains moderate overall. This indicates that the "global AWH field" is not a monolithic block, but an aggregation of distinct national profiles.

Bilateral disciplinary proximity

Bilateral analysis (Table 3) provides a more granular view. Two key patterns émerge:

Higher Bilateral Affinities

Disciplinary proximities between specific country pairs are systematically higher than proximities to the global average. Peripheral countries are rarely "isolated"; they often share strong affinities with specific leaders (e.g., Jordan-France, Namibia-USA) or with other peripheral peers sharing similar environmental contexts (e.g., UAE-Qatar).

Differentiated Leadership

Leading countries play different roles. Some act as broad disciplinary references, while others follow idiosyncratic paths. This relational structure implies that for a peripheral country, the strategic question is not just "how to integrate the global core," but "which specific leader is the most natural partner?"

This leads to the central interrogation of this study: **Do peripheral countries collaborate preferentially with the partners that best match their disciplinary profiles?**

Answering this question makes it possible to assess the strategic coherence of peripheral countries' collaboration patterns, particularly regarding the concentration (or dispersion) of their partnerships with thematically aligned leaders in AWH research.

Collaboration-Disciplinary Proximity (DP) Coherence Analysis

Collaboration structure: Asymmetric dependence on leaders

Leading countries account for 87% of all international collaborations in the AWH field (Figure 6).

China and the USA dominate the landscape, collaborating with eight and seven of the ten peripheral countries, respectively. Dependence patterns are often striking: the USA accounts for ~50% of collaborations for Morocco and Namibia, while China is the primary partner for Belgium (35%) and Qatar (33%).

Peripheral-peripheral collaborations play a secondary but significant role in specific regional contexts, notably between Namibia-South Africa (20-30% of their international flows) and Morocco-Egypt. This centralized structure raises the core question of the study: *Are these dominant collaboration patterns aligned with disciplinary proximity?*

The Egypt-Chile contrast: Illustrating alignment vs. mismatch

Two contrasting cases illustrate the framework logic:

Egypt (Mismatch): Saudi Arabia is Egypt's main partner (32% of collaborations) but has low disciplinary similarity (cosine = 0.23). Conversely, the USA is Egypt's closest disciplinary match among leaders (cosine = 0.40) but does not figure among its main

collaborators. This reveals a clear disconnect between thematic potential and partnership choices.

Chile (Alignment): Chile's main partners (France, USA, and Germany) are also its three closest disciplinary matches (cosine 0.33-0.48). Furthermore, Chile collaborates with Belgium, its closest peripheral peer. This indicates strong coherence between specialization and collaboration.

Taken together, these two cases illustrate contrasting degrees of coherence between disciplinary proximity and collaboration behavior. While Egypt's collaboration network appears weakly aligned with its thematic profile, Chile exhibits a more consistent correspondence between disciplinary orientation and international partnerships. These contrasting configurations provide a concrete empirical basis for extending the collaboration-DP coherence analysis to the full set of peripheral countries.

Typology of Strategic Coherence (Levels 1-4)

Extending this analysis to all ten countries, we identify four levels of coherence. Table 4 illustrates the classification logic.

The Radar charts (Figures 7-10) visualize these configurations by comparing each peripheral country with its three closest partners (among Leaders) on the field's dominant topics.

Table 1: The 30 main Topics in the Global AWH Field.

30 most prolifique Topics	CNCI	Contribution (%)	Cumulus
Superhydrophobic	1.40	36.60%	~80%
Solar Desalination	1.10	28.08%	
Cloud Microphysics	1.05	4.20%	
Atmospheric Aerosols	0.62	3.94%	
Metal-Organic Frameworks	1.81	3.90%	
Color Imaging	0.71	2.65%	
Rangeland Dynamics	0.70	2.61%	
Liquid Desiccant	1.21	1.37%	
Energy Harvesting	2.35	1.28%	
Vapor-Liquid Equilibria	1.86	1.20%	
Casimir Effects	1.04	1.20%	
Photovoltaic Systems	1.06	1.11%	
Building Energy Efficiency	0.93	1.07%	
Enhanced Oil Recovery	0.40	0.98%	
Humidity Sensors	0.61	0.94%	
Energy Systems Optimization	1.11	0.86%	
Radiation Thermometry	1.06	0.77%	
Anaerobic Digestion	1.24	0.73%	
IoT and Edge Computing	0.74	0.73%	
Groundwater Geochemistry	0.74	0.64%	
Forest Dynamics	0.85	0.60%	
Flow Boiling	1.03	0.60%	
Composite Insulators	0.57	0.56%	
Hydroclimatic Modeling	1.11	0.56%	
Nutrient Dynamics	0.51	0.51%	
Corrosion Inhibition	0.59	0.47%	
Stereo Depth Estimation	0.68	0.47%	
ENSO	0.83	0.47%	
Urban Heat Island	0.80	0.47%	
CO_2 Capture	0.82	0.43%	
(+80% of the global corpus)	1.19	100%	

Table 2: Disciplinary Proximity with the Reference Profile and Ranks.

Cosine Similarity	World	Rank (Cosine)	Rank (Pubs.)
China	0.48	1	1
India	0.34	2	3
USA	0.30	3	2
Saudi Arabia	0.27	4	9
Egypt	0.25	5	11
Jordan	0.25	6	16
South Korea	0.25	7	5
UAE	0.22	8	13
Germany	0.19	9	4
Canada	0.17	10	8
Morocco	0.17	11	18
France	0.17	12	10
England	0.16	13	7
Belgium	0.13	14	14
Japan	0.10	15	6
Chile	0.10	16	12
South Africa	0.10	17	15
Qatar	0.05	18	17
Portugal	0.05	19	19
Namibia	0.03	20	20

Level 1: Highly Coherent (Chile, South Africa)

These countries collaborate with all four of their most disciplinarily similar partners (both peripherals and leaders - Table 3 and Figure 6). As shown in Figure 7, both Chile and South Africa exhibit specific specializations outside the global mainstream (e.g., *Cloud Microphysics, Solar Desalination*). Crucially, their chosen leading partners share these specific niches. This configuration suggests that collaboration is effectively leveraged to reinforce existing thematic strengths rather than indiscriminately chasing global trends.

Level 2: Moderately Coherent (Belgium, Jordan, UAE, Namibia)

Countries in this group collaborate with at least one Leader of their four closest disciplinary matches (both peripherals and leaders). The Radar charts (Figure 8) reveal two subgroups:

Selective Alignment

Namibia and the UAE rely on a single highly aligned leader (USA and Saudi Arabia, respectively). However, the UAE shows a latent gap: it has high similarity with India and South Korea (advanced materials leaders) but does not collaborate with them.

Diversified Potential

Belgium shows a more balanced alignment with China and the USA, supported by a broader thematic scope (7 active topics vs. 3 for Jordan). But Jordan shows a high alignment with France with a shared specialisation in the "Groundwater Geochemistry" Topic.

Level 3: Weak-to-moderately coherent (Egypt, Morocco)

These countries collaborate with only one of their top four disciplinary matches, and typically not a leading one. They have only limited overlap with cognitively close leaders

Egypt (Figure 9): Despite a profile similar to the USA and Germany (specialization in 3 of the top 6 topics), Egypt's collaborations skew towards partners with lower disciplinary fit (Saudi Arabia).

Morocco: Similarly, Morocco shows strong affinity with France and Germany but allocates 50% of its collaboration to the USA, where disciplinary proximity is lower (cosine = 0.18). This indicates a divergence between observed collaboration patterns and disciplinary alignment, which may reflect historical, political, institutional, or other factors not taken into account by this bibliometric analysis.

Level 4: Weakly Coherent (Qatar, Portugal)

These countries do not collaborate with any of their top four disciplinary matches (Figure 10). They have no substantial overlap with the closest cognitive matches.

Qatar: Displays balanced similarity with Germany, South Korea, and the USA, yet its collaboration is dominated by China (33%).

Portugal: Shows strong proximity to European peers (Germany, France) but directs partnerships towards China and South Korea. While connecting with global leaders is positive, this lack of thematic alignment may indicate fewer opportunities for cumulative learning based on existing disciplinary skills.

Synthesis

The analysis reveals substantial heterogeneity. While Level 1 countries demonstrate that strategic alignment is possible regardless of size, levels 3 and 4 highlight more pronounced alignment gaps, where existing disciplinary strengths are not complemented by collaborations with the most closely aligned partners. These patterns provide the evidence base for the strategic implications discussed below.

DISCUSSION: FROM ANALYTICAL DIAGNOSIS TO STRATEGIC GOVERNANCE

Beyond its technological dimension, AWH provides an empirical setting to examine how collaboration structures shape learning and catch-up processes in emerging scientific fields.

For peripheral countries, the main issue identified in this study lies in the potential mismatch between existing modes of collaboration and existing disciplinary expertise. Far from suggesting that alignment is always preferable, this perspective underscores the extent to which current partnerships correspond to the country's recognized thematic strengths and can therefore serve as a basis for cumulative learning.

The proposed framework thus constitutes a governance tool that leverages descriptive mapping of publications and collaborations to foster strategic thinking.

The strategic function of Coherence

One of the preliminary findings of this study is that the volume of publications does not accurately describe the coherence of collaboration and Disciplinary Proximity (DP). Indeed, countries comparable in terms of volume (e.g., Chile and Jordan) can exhibit very different levels of strategic maturity. This opens the door to differentiated trajectories for peripheral countries and brings

Table 3: The four closest countries (DP) for each peripheral country.

Peripheral Countries	1st closest country (Cosine)	2nd closest country (Cosine)	3rd closest country (Cosine)	4th closest country (Cosine)	World Cosine
for Egypt	Qatar	Morocco	Belgium	USA	0.25
	0.73	0.55	0.42	0.40	
for Chile	USA	Germany	France	Belgium	0.10
	0.48	0.33	0.33	0.25	
for UAE	Qatar	India	STH-Korea	SA-Arabia	0.22
	0.46	0.43	0.39	0.36	
for Belgium	Portugal	Egypt	China	Chile	0.13
	0.45	0.42	0.26	0.25	
for STH-Africa	Namibia	USA	FRANCE	CHINA	0.10
	0.60	0.45	0.32	0.27	
for Jordan	Morocco	France	Namibia	China	0.25
	0.61	0.60	0.23	0.19	
for Qatar	Egypt	Morocco	UAE	Germany	0.05
	0.73	0.61	0.46	0.36	
for Morocco	Jordan	Qatar	Egypt	France	0.17
	0.61	0.61	0.55	0.40	
for Portugal	Belgium	Germany	Egypt	France	0.05
	0.45	0.37	0.36	0.35	
for Namibia	STH-Africa	USA	France	Jordan	0.03
	0.60	0.35	0.32	0.23	

Table 4: **Synthesis of collaboration-specialization coherence across the 10 peripheral countries.**

Country	# of collaborators out of the Top 4 closest countries (DP)	Leading Collaborators (in Top 4 - DP)	Top 3 Closest Leaders (DP)	Overlap	Coherence level
Chile	4 (3 Leaders)	France, USA, Germ.,	USA, Germ., France	High 3/3	Level 1
South-Africa	4 (3 Leaders)	USA, France, China	USA, France, China	High 3/3	Level 1
Jordan	2 (2 Leader)	France, China	France, China, India	Moderate 2/3	Level 2
Belgium	2 (1 Leader)	China	China, USA, Japan	Moderate 1/3	Level 2
Namibia	2 (1 Leader)	USA,	USA, France, Japan	Partial 1/3	Level 2
UAE	1 (1 Leader)	Saudi Arabia,	India, South-Korea, S-Arabia	Partial 1/3	Level 2
Egypt	1 (0 Leader)	-	USA, Germ., China	Low 0/3	Level 3
Morocco	1 (0 Leader)	-	France, Germ., China	Low 0/3	Level 3
Qatar	0 (0 Leader)	-	Germ., South-Korea, USA	Very low 0/3	Level 4
Portugal	0 (0 Leader)	-	Germ., France, USA	Very low 0/3	Level 4

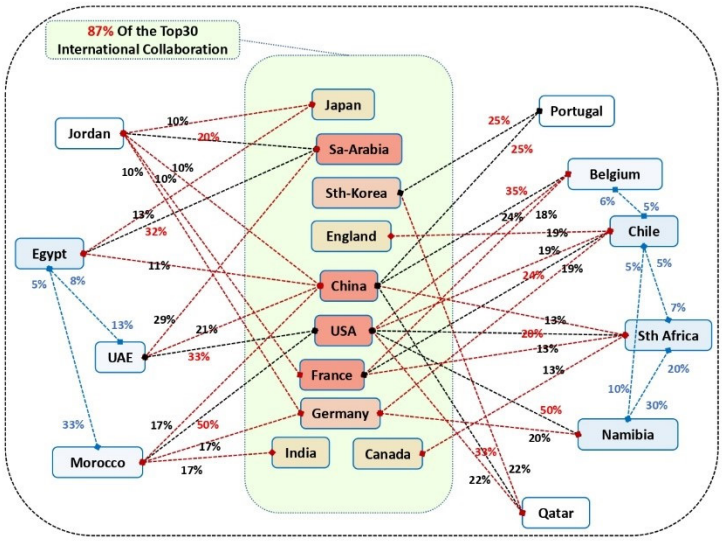


Figure 6: Main collaborators of the Peripheral countries in the AWH field.

the role of science policy back into focus. These findings suggest that policymakers could consider this mechanism for measuring qualitative alignment, in addition to quantitative approaches. The objective is to promote the structural integration of a peripheral country while ensuring thematic coherence with international partners.

Importantly, alignment should not be equated with optimality, nor should cognitive similarity be considered inherently superior to complementarity. Cognitively distant partners may provide access to knowledge, methods, technologies, or capabilities that are not yet developed within the peripheral system. The present framework addresses a narrower question: whether observed collaboration patterns correspond to the country's existing disciplinary specialization within the cognitive core of the field. Alignment therefore captures a potential basis for cumulative learning and consolidation of existing capabilities, whereas complementary collaboration may serve capability acquisition and diversification. These two dimensions are analytically distinct and potentially complementary.

Furthermore, the observed disciplinary profiles should not be interpreted solely as fortuitous dynamics of scientific specialization. They actually reflect underlying scientific positioning and institutional capacities adopted by the peripheral country in the relevant field (e.g., AWH).

However, when peripheral countries collaborate primarily with partners whose disciplinary profiles are distant from their own, the observed configuration may provide fewer opportunities for cumulative learning based on existing capabilities. Conversely, a stronger alignment between specialization and collaboration could improve strategic efficiency and foster more autonomous governance of innovation in strategic areas. Such patterns should not, however, be interpreted as evidence of reduced absorptive capacity or of a causal pathway towards scientific dependence. Rather, they indicate a potential mismatch between existing specialization and the thematic orientation of major collaborative partners.

Widely shared in the literature (Boelens *et al.*, 2019; Mollinga, 2008; Wilson *et al.*, 2019). This observation stipulates that water governance is not solely the responsibility of administrative bodies but also of researchers and techno-scientific institutions. In this sense, asymmetries in research capacity, international collaboration and disciplinary positioning constitute a highly relevant, but still little explored dimension for studying hydro-hegemony and its relationship with science policy and water governance, within a broader co-production framework (Gaillard, 2010; Umer and Khan, 2025; Wagner, 2008).

Strategic Pathways and Illustrative Cases

Illustrated by the AWH case, this analysis has revealed at least three distinct options that could inspire stakeholders in STI governance. The proposed framework thus allows for the formulation of evidence-based, operational recommendations to stimulate strategic thinking.

Pathway 1: Consolidating Niche Specialization (The Chile Model) *High Coherence Strategy*

Chile is demonstrating a coherent approach that suggests strong convergence and strategic consolidation. Its collaborative choices with leading countries, such as France, Germany, and the USA, are focused on its area of specialization (*Cloud Microphysics*). From a strategic perspective, this consistency is compatible with a configuration likely to promote the consolidation of its specialization by facilitating cumulative learning with more developed countries. This would also improve its visibility and attractiveness to international funding without dispersing its research efforts. In this context, such collaboration may reinforce national priorities and provide a potentially supportive condition for catch-up.

Pathway 2: Realignment and Efficiency (The Morocco/Egypt Challenge) Realignment Opportunity

Conversely, Morocco is a typical example of a lack of alignment and its potential impact on optimizing national capabilities. While Morocco shares strong thematic similarities with France and Germany, its collaboration is primarily oriented towards other partners with more distant specializations (e.g., the USA). This may provide fewer opportunities for structured knowledge accumulation within its specialized niches. In these cases (levels 3 and 4), this pattern can be interpreted as a misalignment between specialisation and collaboration, potentially limiting opportunities for cumulative learning within existing areas of specialization. A realignment could then be considered to encourage the institutions concerned and their researchers to redirect their partnerships towards actors with closer thematic affinities, rather than limiting themselves to established relationships offering few synergies.

In reality, such a measure cannot be directly imposed administratively. However, science policy bodies can play a catalytic role by directing funding and providing strategic information and analytical tools that help research teams better understand their environment and its trends. In this sense, the proposed analytical framework of collaboration-specialization alignment can serve as a decision-making tool. It allows

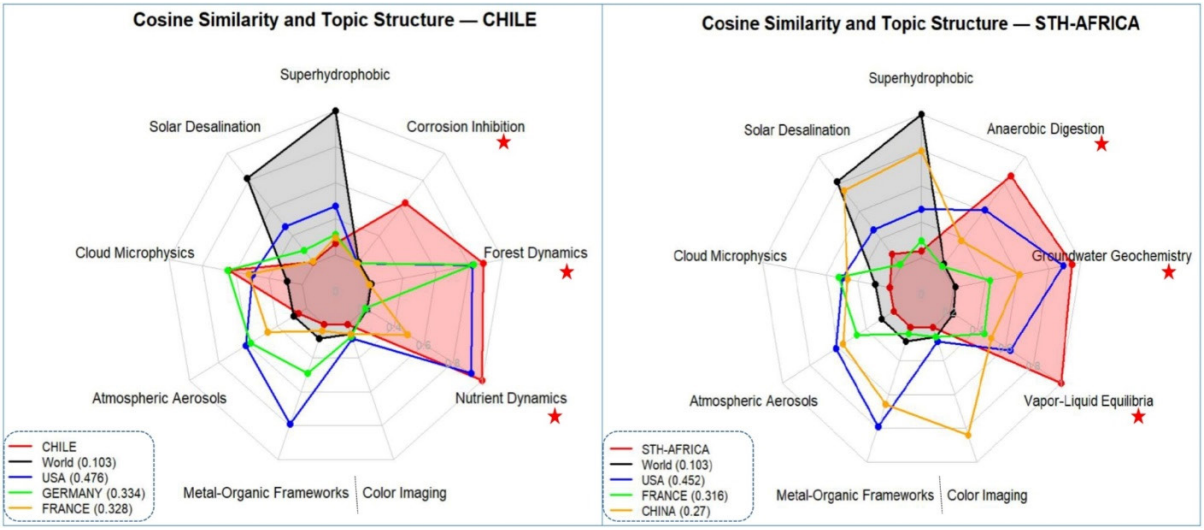


Figure 7: Condensed representation of disciplinary profiles for Level 1 countries (Chile and South Africa).

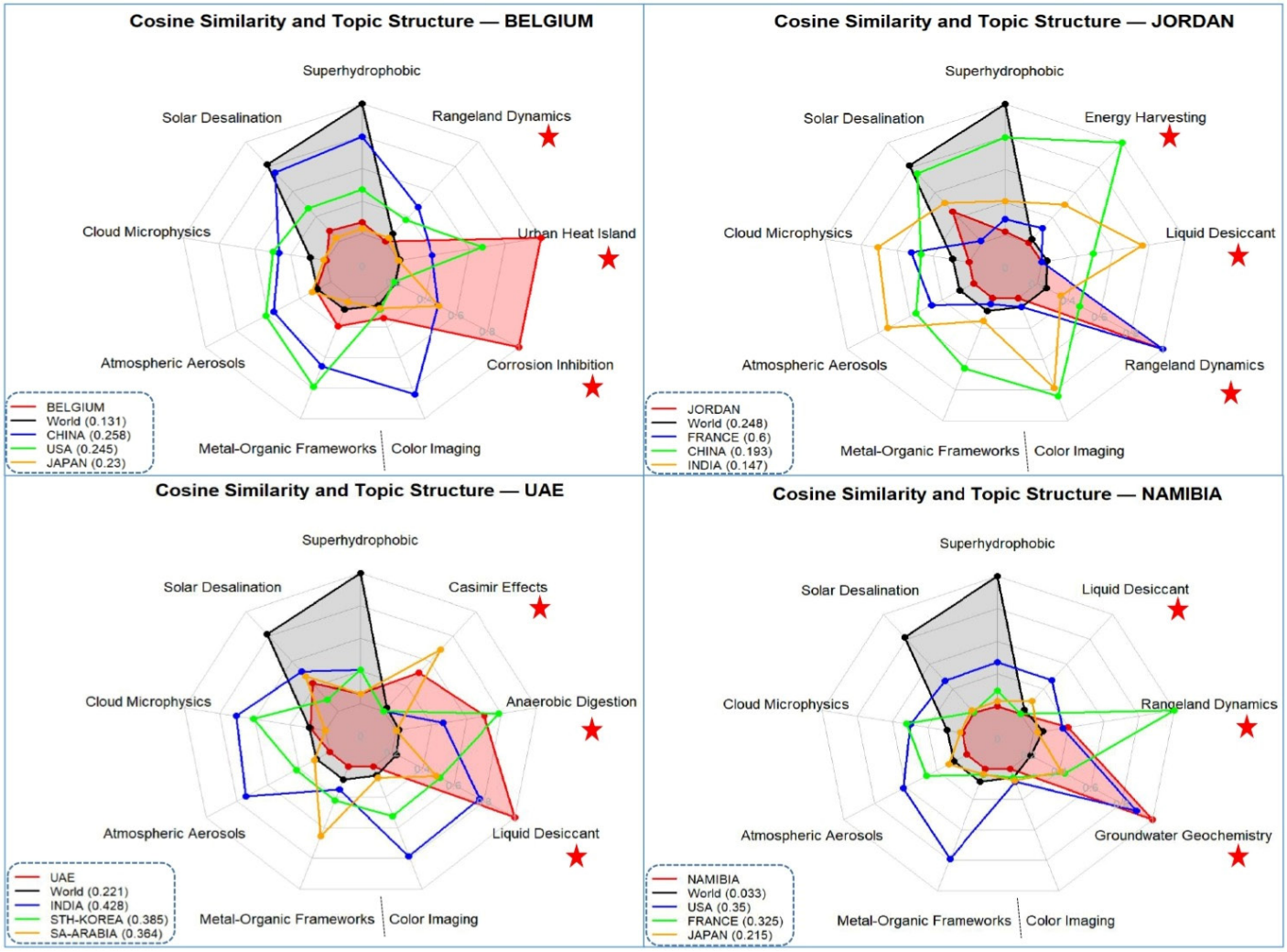


Figure 8: Condensed representation of disciplinary profiles for Level 2 countries.

institutions to evaluate current and potential partnerships themselves, based on disciplinary proximity and the potential for cumulative learning.

Pathway 3: Leveraging South-South Complementarities for Regional Critical Mass

The analysis also revealed the formation of certain clusters among peripheral countries, such as the one comprising South Africa, Namibia, and Chile. This may reflect shared conchallenges, particularly climate and environmental constraints and governance frameworks, could naturally stimulate this kind of collaboration. This creates favourable conditions for cooperation and the pooling of efforts to achieve critical mass around local challenges.

Promoting and encouraging this collaborative core is a prerequisite for more assertive formalization and greater influence on international research agendas. Coordinated efforts in scientific diplomacy, the exchange of experts and best practices, and the pooling of regional experimental platforms would foster thematic complementarities among these peripheral research systems, which share comparable constraints.

Methodological Contributions and Limitations

This study proposes an operational analytical framework for assessing the coherence between collaborative practice and disciplinary profile, as a structuring dimension of scientific positioning. This approach deliberately neutralizes volume to allow for a comparable analytical perspective for heterogeneous systems. Thus, bibliometric mapping is used to describe the general structure of research in the field (AWH) and as a governance diagnostic tool, revealing asymmetries and coherences.

By design, this approach is limited to bibliometric data, which deprives it of the analytical input that can come from other sources, such as funding, patents, informal or industrial relationships, etc. Secondly, due to the volume neutralization, the analysis does not address the structural asymmetry that exists between very large and very small systems. Finally, collaboration between peripheral countries is an important aspect that warrants dedicated exploration.

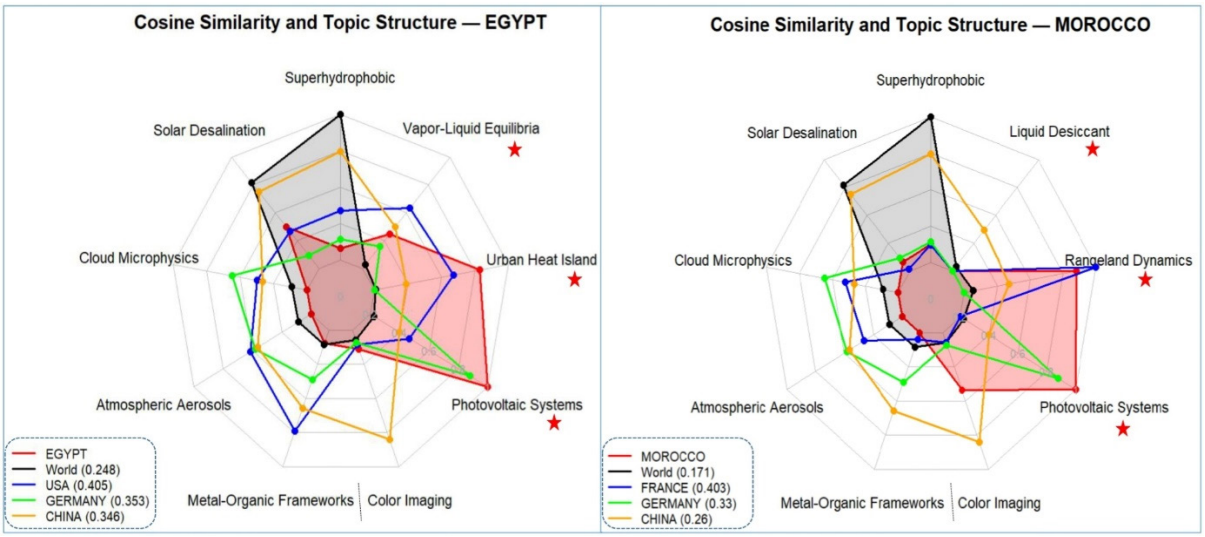


Figure 9: Condensed representation of disciplinary profiles for Level 3 countries.

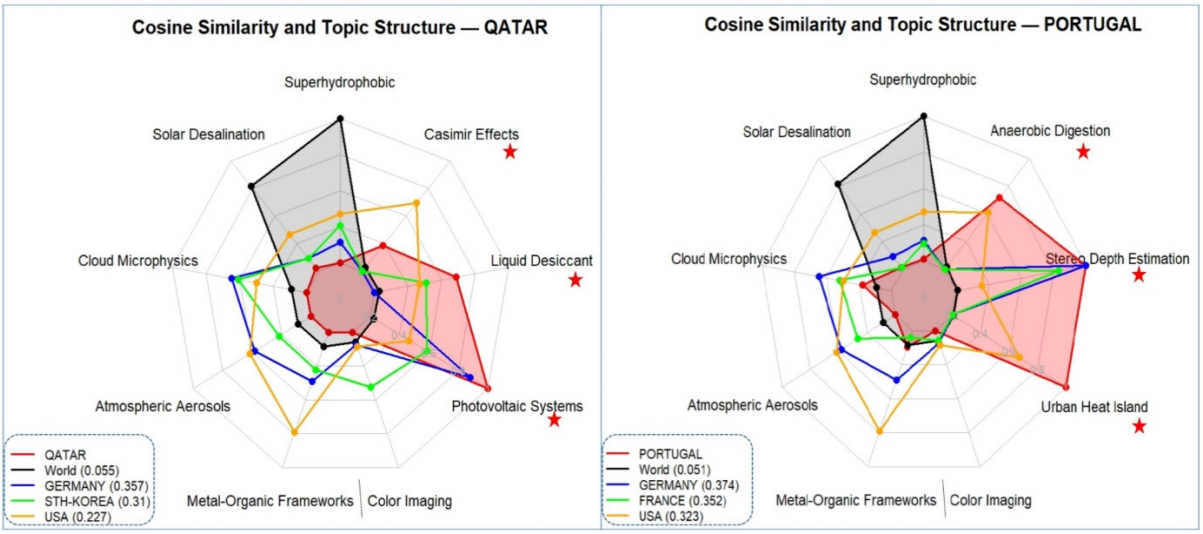


Figure 10: Condensed representation of disciplinary profiles for Level 4 countries.

CONCLUSION

Adopting emerging technologies, such as Atmospheric Water Harvesting (AWH), depends not only on economic and institutional conditions, but also on the structure of scientific capacities and patterns of international collaboration. This study shows that peripheral countries follow heterogeneous trajectories in their efforts to catch up scientifically. It focuses on the alignment between national disciplinary strengths and international collaboration strategies, and its role in developing learning capacities and technological positioning.

By revealing the gap between "who we are scientifically" and "who we collaborate with," the proposed Core-Periphery alignment framework offers a systematic and reproducible approach to assessing the coherence of collaboration modes within emerging scientific fields. From this perspective, it makes it possible to identify underexplored or weakly aligned partnership configurations, and to assess the link between these collaborative structures and the disciplinary profile of the peripheral country.

More broadly, the results suggest that the intensity of collaboration alone is not a sufficient indicator of effective knowledge integration. The degree of alignment between specialization and collaboration appears to be a relevant dimension of scientific positioning, with implications for potential learning opportunities and the configuration of countries' integration into global knowledge networks.

For this analytical perspective to inform practice, institutional support structures can play a facilitating role. Science and technology observatories, strategic intelligence units, or foresight programs could operationalize these analyses by monitoring collaboration patterns, mapping disciplinary proximities, and providing structured insights to research communities. These mechanisms can also integrate complementary forms

of knowledge -such as the analysis of innovation policies and financial flows or expert consultation- to contextualize bibliometric data.

More broadly, this approach contributes to a more reflexive governance of scientific internationalization, where collaboration models are not only measured retrospectively, but also evaluated and adjusted according to national research needs and capacities.

Ultimately, strengthening the scientific and technological positioning of peripheral countries may require moving beyond purely opportunistic collaboration towards more consciously structured partnership portfolios. In this context, alignment between scientific specialization and collaboration constitutes one relevant dimension for understanding how peripheral countries integrate into global knowledge systems and shape their technological trajectories.

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During the preparation of this manuscript, the authors state that they used an AI tool solely for grammatical correction and some rewording to improve language clarity. All ideas, arguments, and final decisions reflect the authors' independent research.

ABBREVIATIONS

AWH: Atmospheric Water Harvesting; **MOFs:** Metal-Organic Frameworks; **AI:** Activity Index; **DP:** Disciplinary Proximity; **MENA:** Middle East and North Africa; **STI:** Science, Technology, and Innovation; **IRD:** Research Institute for Development; **IMIST-CNRST:** National Center for Scientific and Technical Research.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Appendix A: Activity Indexes of the 10+10 countries for the 30 topics of the World Reference in AWH Research 2015-2025.

The 30 Topics of the World Reference	%	China	USA	India	Germany	South-Korea	Japan	England	Canada	SA-Arabia	France	Egypt	Chile	UAE	Belgium	South-Africa	Jordan	Qatar	Morocco	Portugal	Namibia
Superhydrophobic	36.6%	1.2	0.9	0.8	0.8	1.1	0.7	1.1	1.0	0.4	0.9	0.5	1.0	0.6	1.0	0.6	0.2	0.0	1.1	0.3	0.0
Solar Desalination	28.1%	1.1	0.9	1.2	0.6	0.5	0.5	0.9	0.8	1.9	0.1	2.2	0.1	2.1	1.1	1.4	2.5	1.0	0.7	0.4	0.7
Cloud Microphysics	4.2%	0.5	1.1	1.9	3.1	2.2	0.3	2.1	2.6	0.0	3.2	0.0	7.4	0.8	0.0	0.0	0.0	0.0	0.0	6.0	0.0
Atmospheric Aerosols	3.9%	0.7	1.5	2.1	2.6	1.2	2.5	1.1	1.2	0.7	2.6	0.0	0.9	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Metal-Organic Frameworks	3.9%	0.9	2.1	0.6	2.0	1.2	0.7	1.1	0.0	3.0	0.4	0.6	0.0	0.0	2.7	0.0	0.0	0.0	0.0	3.2	0.0
Color Imaging	2.7%	1.3	0.3	2.2	0.5	1.8	1.6	0.0	0.0	0.5	0.6	0.8	0.0	0.0	2.0	0.0	0.0	0.0	3.8	0.0	0.0
Rangeland Dynamics	2.6%	0.5	0.6	0.6	0.0	0.0	0.5	1.1	0.0	0.5	7.9	0.0	2.6	0.0	0.0	2.9	8.2	0.0	7.7	0.0	15.3
Liquid Desiccant	1.4%	0.6	1.0	2.2	0.0	1.7	2.1	0.0	1.2	1.9	0.0	1.6	0.0	7.6	0.0	0.0	0.0	19.9	0.0	0.0	0.0
Energy Harvesting	1.3%	1.6	0.0	1.2	0.0	0.9	0.0	0.0	2.5	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vapor-Liquid Equilibria	1.2%	0.6	1.5	0.0	1.1	0.0	0.0	1.2	4.0	0.0	2.5	1.9	0.0	0.0	0.0	12.8	0.0	0.0	0.0	0.0	0.0
Casimir Effects	1.2%	1.4	1.7	0.0	0.0	0.0	0.0	0.0	0.0	3.3	2.5	1.9	0.0	2.9	0.0	0.0	0.0	7.6	0.0	0.0	0.0
Photovoltaic Systems	1.1%	0.4	0.9	0.0	4.6	2.1	2.5	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	32.7	9.0	0.0	0.0
Building Energy Efficiency	1.1%	0.9	0.2	0.0	2.4	4.3	6.6	0.0	3.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Enhanced Oil Recovery	1.0%	0.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Humidity Sensors	0.9%	0.6	1.1	0.8	1.4	3.7	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy Systems Optimization	0.9%	0.7	0.9	0.9	1.5	1.4	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Radiation Thermometry	0.8%	0.1	0.3	0.0	0.0	0.0	3.7	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Anaerobic Digestion	0.7%	0.4	1.4	1.0	0.0	3.2	1.9	4.0	0.0	0.0	0.0	0.0	0.0	4.7	0.0	10.6	0.0	0.0	0.0	17.2	0.0
IoT and Edge Computing	0.7%	0.5	0.4	3.1	0.0	1.6	0.0	0.0	2.2	1.8	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Groundwater Geochemistry	0.6%	0.8	2.4	1.2	2.0	0.0	4.4	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0	62.3
Forest Dynamics	0.6%	0.6	2.2	0.0	4.3	0.0	2.4	0.0	0.0	0.0	0.0	0.0	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Boiling	0.6%	0.9	1.3	1.2	2.1	1.9	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Composite Insulators	0.6%	0.5	0.0	0.0	0.0	0.0	0.0	10.4	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydroclimatic Modeling	0.6%	1.3	2.8	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nutrient Dynamics	0.5%	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	13.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Corrosion Inhibition	0.5%	0.6	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	7.3	0.0	11.2	0.0	0.0	0.0	0.0	0.0	0.0
Stereo Depth Estimation	0.5%	1.1	0.6	0.0	5.4	0.0	0.0	0.0	3.4	0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.5	0.0
ENSO	0.5%	0.9	0.6	1.6	2.7	0.0	0.0	6.2	3.4	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Urban Heat Island	0.5%	0.4	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.0	0.0	11.2	0.0	0.0	0.0	0.0	26.5	0.0
CO2 Capture	0.4%	0.1	0.1	0.0	0.3	0.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix B: Bis. Cosine similarities between each couple of countries and vis-à-vis the Global Reference of AWH Research 2015-2025.

Cosine/DP	China	USA	India	Germany	STH-KOREA	Japan	England	Canada	SA-ARABIA	France	Egypt	Chile	UAE	Belgium	STH-AFRICA	Jordan	Qatar	Morocco	Portugal	Namibia	World
China	1,000	0,712	0,642	0,592	0,557	0,385	0,316	0,539	0,525	0,522	0,346	0,196	0,312	0,258	0,270	0,193	0,207	0,260	0,283	0,210	0,48
USA	0,712	1,000	0,462	0,558	0,432	0,370	0,212	0,302	0,392	0,446	0,405	0,476	0,322	0,245	0,453	0,121	0,227	0,177	0,323	0,351	0,30
India	0,642	0,462	1,000	0,392	0,610	0,302	0,281	0,349	0,363	0,423	0,164	0,144	0,428	0,107	0,220	0,147	0,182	0,187	0,122	0,204	0,34
Germany	0,592	0,558	0,392	1,000	0,498	0,380	0,214	0,386	0,170	0,496	0,353	0,334	0,041	0,064	0,173	0,019	0,357	0,330	0,374	0,180	0,19
STH-Korea	0,557	0,432	0,610	0,498	1,000	0,679	0,192	0,283	0,299	0,157	0,262	0,106	0,385	0,072	0,200	0,020	0,311	0,256	0,205	0,001	0,25
Japan	0,385	0,370	0,302	0,380	0,679	1,000	0,076	0,107	0,111	0,092	0,123	0,183	0,134	0,230	0,178	0,033	0,156	0,133	0,044	0,215	0,10
England	0,316	0,212	0,281	0,214	0,192	0,076	1,000	0,754	0,064	0,249	0,048	0,074	0,180	0,031	0,227	0,102	0,002	0,062	0,153	0,021	0,16
Canada	0,539	0,302	0,349	0,386	0,283	0,107	0,754	1,000	0,127	0,393	0,109	0,086	0,111	0,018	0,207	0,021	0,050	0,011	0,206	0,001	0,17
SA-Arabia	0,525	0,392	0,363	0,170	0,299	0,111	0,064	0,127	1,000	0,192	0,228	0,015	0,364	0,097	0,026	0,131	0,208	0,075	0,032	0,018	0,27
France	0,522	0,446	0,423	0,496	0,157	0,092	0,249	0,393	0,192	1,000	0,096	0,328	0,085	0,032	0,316	0,600	0,038	0,403	0,352	0,325	0,17
Egypt	0,346	0,405	0,164	0,353	0,262	0,123	0,048	0,109	0,228	0,096	1,000	0,004	0,271	0,421	0,152	0,078	0,729	0,552	0,357	0,003	0,25
Chile	0,196	0,476	0,144	0,334	0,106	0,183	0,074	0,086	0,015	0,328	0,004	1,000	0,035	0,249	0,020	0,125	0,000	0,083	0,051	0,031	0,10
UAE	0,312	0,322	0,428	0,041	0,385	0,134	0,180	0,111	0,364	0,085	0,271	0,035	1,000	0,019	0,266	0,065	0,463	0,018	0,217	0,002	0,22
Belgium	0,258	0,245	0,107	0,064	0,072	0,230	0,031	0,018	0,097	0,032	0,421	0,249	0,019	1,000	0,006	0,022	0,002	0,046	0,450	0,001	0,13
STH-africa	0,270	0,453	0,220	0,173	0,200	0,178	0,227	0,207	0,026	0,316	0,152	0,020	0,266	0,006	1,000	0,156	0,002	0,094	0,210	0,595	0,10
Jordan	0,193	0,121	0,147	0,019	0,020	0,033	0,102	0,021	0,131	0,600	0,078	0,125	0,065	0,022	0,156	1,000	0,007	0,606	0,003	0,231	0,25
Qatar	0,207	0,227	0,182	0,357	0,311	0,156	0,002	0,050	0,208	0,038	0,729	0,000	0,463	0,002	0,002	0,007	1,000	0,605	0,000	0,000	0,05
Morocco	0,260	0,177	0,187	0,330	0,256	0,133	0,062	0,011	0,075	0,403	0,552	0,083	0,018	0,046	0,094	0,606	0,605	1,000	0,001	0,147	0,17
Portugal	0,283	0,323	0,122	0,374	0,205	0,044	0,153	0,206	0,032	0,352	0,357	0,051	0,217	0,450	0,210	0,003	0,000	0,001	1,000	0,000	0,05
Namibia	0,210	0,351	0,204	0,180	0,001	0,215	0,021	0,001	0,018	0,325	0,003	0,031	0,002	0,001	0,595	0,231	0,000	0,147	0,000	1,000	0,03
World	0,48	0,30	0,34	0,19	0,25	0,10	0,16	0,17	0,27	0,17	0,25	0,10	0,22	0,13	0,10	0,25	0,05	0,17	0,05	0,03	1,00