





Review

Nature-Based Water Harvesting Systems for Climate-Resilient Buildings: A Scoping Literature Review

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Abstract

Water, a precious but limited resource since prehistoric times, has driven humans to develop systems for collecting and storing it. Evidence dating back to third millennium BC documents shows such systems among the Sumerians in the Fertile Crescent, as well as in Asia, Africa, China, and India. Aqueducts and cisterns, along with impluvium–compluvium systems, allowed the Romans to meet private and public needs; in Venice, wells provided filtered water until 1884. Today, climate change and increasing soil sealing urgently demand intelligent water collection and management, aligned with five of the 2030 Agenda Sustainable Development Goals (6, 11, 12, 13, 15). Buildings and construction account for about 35% of the global freshwater consumption. The construction sector, historically involved in the development of innovative rainwater harvesting and reuse systems, now faces a growing challenge in exploring innovative nature-based solutions for climate-resilient buildings (e.g., fog harvesting, green roofs for rainwater storage). Based on these considerations, we propose a scoping literature review of the last 15 years on innovative rainwater harvesting and storage systems. The analysis aims to provide a comparative mapping of the technological solutions that have emerged, to identify the geographical areas and climatic conditions favourable to each system, and to serve as a knowledge base for the development of integrated construction systems suitable for each specific context. A total of 136 peer-reviewed Open Access articles indexed in Scopus (2010–2024) were analysed following the PRISMA-ScR guidelines.

Keywords: rainwater harvesting system; rainwater harvesting; fog collector; fog harvesting; climate-resilient buildings; nature-based systems



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1. Introduction

Climate change and urbanisation have intensified the pressure on conventional water infrastructure, prompting the building sector to adopt adaptive strategies that enhance resilience while reducing dependence on centralised systems. Globally, water withdrawals are dominated by agriculture (~70%), followed by industry (~20%) and municipal uses (~10%). Within this framework, the building and construction sector represents a significant share of freshwater use [1]. Direct withdrawals associated with construction activities are estimated to be approximately 15% of global freshwater use, while lifecycle-based assessments—including material production, construction processes, and building operation—indicate that the sector’s total water footprint may approach 30%. This demand

is driven by material production (e.g., concrete and steel), on-site processes, and operational consumption in buildings [2]. Moreover, demand is rising as temperatures increase and precipitation patterns become erratic [3]. Nature-based water-harvesting systems integrate ecological processes with built-environment infrastructure, leveraging vegetation, soil–water interactions, and biogeochemical cycles to capture, store, and treat precipitation at the building scale. Historical precedents demonstrate the viability of localised water harvesting [4–6].

Despite the growing adoption of individual technologies, such as fog collectors [7,8] and sponge concrete [9], their integration into unified building-scale systems remains limited. The existing literature addresses discrete components such as rainwater-harvesting efficiency [10], roof-geometry optimisation [11], or bioretention sizing. This review examines nature-based water-harvesting systems, evaluating peer-reviewed research, case studies, and technical reports over the last 15 years, focusing on temperate, subtropical, and Mediterranean climate zones where water stress and climate variability challenge efforts to build water security. This review contributes to expanding the existing body of knowledge by providing a structured mapping of nature-based water harvesting technologies, their application contexts, and emerging research trends, highlighting areas that remain largely unexplored and supporting future research and design strategies in the climate-resilient building systems domain.

2. Motivation

Three converging imperatives drive this review: climate adaptation requirements, water resource constraints aligned with the UN Sustainable Development Goals (SDGs 6, 11, 12, 13, 15) [12], and regenerative building design frameworks [13]. Building codes and rating systems [14,15] increasingly require climate-resilient features. Nature-based systems deliver multiple ecosystem services. In addition, RWHSs can contribute to flood mitigation by increasing the time required for rainwater to reach the drainage system, thereby reducing the peak runoff and improving the overall stormwater management. Municipal utilities in water-stressed regions implement demand management programs and tiered pricing that incentivise on-site capture and reuse, with buildings achieving significant potable water offsets depending on roof area, precipitation, and end-use applications [16,17]. Understanding system performance across contexts, economic viability, and implementation barriers will inform architects, engineers, and building scientists in climate-responsive design.

However, the recent literature has not comprehensively documented the scope, geographic distribution, climatic applicability, and performance characteristics of these technologies.

This paper details a Scoping Literature Review following the PRISMA Extension for Scoping Reviews (PRISMA-ScR) guidelines, examining peer-reviewed publications from the last fifteen years. In line with typical scoping review methods, the goal is not to synthesise evidence for specific intervention recommendations or to evaluate individual studies through risk-of-bias assessments. Instead, this review aims to map the existing literature, to categorise the various types of nature-based water harvesting systems used in building and construction, to identify the geographic and climatic conditions linked to each system type, and to highlight gaps in the current knowledge. This knowledge base is designed to support future-focused research and to guide the development of context-specific, integrated construction systems.

3. Synthesis and Research Questions

Effective and climate-resilient water management requires integrating multiple aspects, such as traditional knowledge combined with innovative technologies, technical feasibility

supported by economic sustainability, and appropriate regulatory and institutional frameworks. The literature shows that the effectiveness of such systems depends heavily on a tailored design for each specific context. Fog harvesting is suitable for specific coastal areas; sponge concrete requires space for large, pervious surfaces; first-flush systems are most effective where roof contamination is significant. Each technology occupies a niche rather than providing a universal solution. The challenge is to match technologies to contexts based on climate, hydrology, economics, social preferences, and policy implementation.

The papers reviewed highlight nature-based water harvesting systems as promising components of climate-resilient infrastructure. However, issues relating to long-term integration with conventional infrastructure, maintenance models, and economic viability are inconsistently addressed across the selected papers and fall outside the scope of this scoping review, which instead focuses on mapping technologies, contexts, and applications.

In light of these findings, this scoping review aims to answer the following three main questions (RQs):

1. What is the geographical distribution and chronological trend of the studies on nature-based water harvesting systems in the building and construction sector, distinguishing between the country of scientific production and the country of documented implementation?
2. Which of the nature-based water harvesting technologies and technological configurations are most frequently investigated in the literature, and which are documented in implemented case studies?
3. At what scale of application (building, site, urban, regional) and on which building elements or physical locations are these technologies predominantly studied and implemented?
4. What are the primary and secondary aims pursued in the literature on nature-based water harvesting systems, and how are these aims distributed across the study period?
5. In which climatic contexts are nature-based water harvesting systems predominantly studied and implemented, and which climatic zones remain under-represented in the literature?

4. Framing Background

Ancient water harvesting systems—Greek cisterns, Roman aqueducts and impluvium-compluvium configurations, Venetian filtered wells, Chinese bell-shaped water cellars, and Nepalese Pokhari basins—established enduring design principles, such as underground storage to minimise evaporation, catchment optimisation using available surfaces, and construction adapted to local materials [18]. Their reliability over centuries has stemmed from passive operation, energy independence, and maintenance within household-level capabilities [6]. Climate change and accelerating urbanisation now urgently challenge these principles at scale: rising temperatures intensify evaporation, precipitation concentrates in intense events causing flooding rather than groundwater recharge, and impervious surfaces compound scarcity during dry periods [3,19,20]. Decentralised, nature-based systems—fog collectors, sponge concrete, first-flush diverters, green roofs, bioswales, and integrated wetlands—respond to these pressures by capturing, storing, and treating precipitation at the building scale, while delivering co-benefits, including urban heat island mitigation, stormwater management, evaporative cooling, and biodiversity support [7,9,16,21–23]. Economic evidence supports their adoption: harvested rainwater costs 0.16–0.28 USD/m³ against municipal supply costs of 0.37–1.4 USD/m³ [24], and payback periods are calculable from the catchment area, conventional water price, and initial investment [25]; however, viability depends more on context than technology, and policy instruments—from mandatory requirements (Belgium, Germany) to incentives covering 30–50% of installation costs—are

frequently necessary for widespread uptake [10,19,26]. It is important to note that the comparison involves water sources with different quality characteristics. In addition, the cost of potable water is often influenced by socio-political factors and may be underestimated, which should be considered when interpreting the economic results.

Roof material and pitch, first-flush diversion, and cascade reuse strategies all influence water quality outcomes, though bacterial contamination in storage can exceed potable limits, and treatment intensity must be matched to end use [11,27,28]. Despite this body of knowledge, the following critical gaps persist: standardised design methodologies, performance benchmarks, and lifecycle assessment protocols suited to building-scale practice are absent [29]; climate downscaling from regional projections to building-scale design parameters remains underdeveloped [30]; integrated guidance for multi-component systems at neighbourhood and district scales is lacking; long-term maintenance frameworks for decentralised systems—without which field performance degrades rapidly—are unresolved; and co-benefit valuation methodologies acceptable to regulatory agencies and financial institutions do not yet exist. This review is framed by these antecedents and gaps.

5. Methodology

This scoping review examines the evolution of methods, strategies, and tools for rainwater and fog harvesting in the construction sector, with a particular focus, where possible, on their application to buildings, aiming to identify and highlight the unexplored potential.

No specific review protocol was documented for this scientific literature review, but it was conducted in accordance with the PRISMA-ScR guidelines, adopting a structured methodology to guide the selection and analysis of data in a progressive and targeted manner.

In line with the scoping review methodology, no formal critical appraisal of the studies examined was conducted. The aim of this scoping review is not to assess the methodological rigour of each selected article but to outline the scope and characteristics of the existing evidence for the exploitation of unexpressed or underutilised opportunities.

This approach aligns with the PRISMA-ScR guidelines, which consider critical appraisal optional for scoping reviews. The completed PRISMA-ScR checklist is available in Appendix A, Figure A1 [31].

5.1. Literature Selection Process

To provide an accurate and systematic analysis of the technologies and strategies used for rainwater and fog harvesting, a structured methodology was adopted to identify and analyse a large number of scientific publications, selecting the most relevant ones. The aim was to explore the evolution of the technologies and methods used in the AEEO (Architecture, Engineering, Construction, and Operations) sector to collect and reuse rainwater and fog, thereby reducing drinking water consumption and managing the challenges posed by severe flooding.

5.2. Database Selection

To conduct this scoping review, we used Elsevier's Scopus database, widely regarded as one of the most reliable sources of scientific literature for its broad disciplinary coverage and high-quality indexed content. Although this choice may result in a partial loss of contributions, it ensures an accurate and replicable dataset.

5.3. Preliminary Analysis and Selection of the Operative Keywords

The search keywords were defined through multiple analyses and stages to identify the most appropriate terms to describe and define the topic of rainwater harvesting and reuse. These stages, conducted directly in the Scopus databases, enabled us to test various keyword combinations, including synonyms and alternative terminology.

The preliminary analysis involved defining the main set for subsequent screening. In this case, wishing to address the above topic solely from the perspective of the AECO sector, without delving into the issue of water quality and, in general, without branching out into chemical–physical areas, the union of the keywords “Building*” and “Construction*” was set as the base set, for a total of 3,185,952 articles.

The next phase, using the Boolean operators “AND” and “OR”, further defined the database by isolating articles on topics represented by the following keywords: “Rainwater Harvesting”, “Rainwater Harvesting System*”, “Fog Collector*”, and “Fog Harvesting”. This allowed for the consolidation of a database of 1275 articles.

In addition to the application of the Boolean operators, the use of the special wildcard character asterisk (*) allowed for both the singular and plural forms of the keywords to be included without having to specify them manually in the search interface, significantly improving the effectiveness of the search. This approach produced a more representative and relevant set of papers, aligning with the objectives of this scoping review.

The search strategy set up in the database was based on three key elements of the articles—keywords, abstracts, and titles—to identify the highly relevant publications and to discard those that only deal with the topic marginally.

5.4. Inclusion and Exclusion Criteria

Starting with a dataset of 1275 papers selected by keyword, we further narrowed it for analysis by applying filters in the Elsevier Scopus database.

As a first filter, we limited the selection to scientific “Articles” and “Conference Papers” to refine the main sources of up-to-date academic contributions on the subject. Other types of contributions, such as reviews and editorials, were excluded to maintain the focus on studies based on validated analyses and methodologies. Filters for source type (“Journal” and “Conference Proceedings”) and language (“English” only) were also applied to further refine the results.

The research reference period, initially set at 25 years from 2000 to 2024, was reduced to 15 years (“2010–2024”) to ensure consistency in the density of the data sets after applying the Open Access filter. After applying the last two constraints in the Elsevier Scopus search interface, including the restriction to “All Open Access”, the number of papers was reduced from 887 to 343. Table 1 summarises all the filters applied.

Table 1. Filters selected on Scopus.

Year Range	2010–2024
Document type	Article
	Conference Paper
Source type	Journal
	Conference Proceedings
Language	English
Open access	All Open Access

5.5. Full Search Strategy

In order to identify the final dataset of papers useful for beginning the analysis, the following search string was entered into the Scopus database:

TITLE-ABS-KEY (“building” OR “construction*”) AND TITLE-ABS-KEY (“rainwater harvesting system*” OR “rainwater harvesting” OR “fog collector*” OR “fog harvesting”) AND PUBYEAR > 2009 AND PUBYEAR < 2025 AND (LIMIT-TO*

(SRCTYPE, "j") OR LIMIT-TO (SRCTYPE, "p")) AND (LIMIT-TO (OA, "all")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp")) AND (LIMIT-TO (LANGUAGE, "English"))

This research was conducted on 23 October 2025, and its results reflect the database coverage and indexing status at that date.

5.6. Classification and Validation Criteria for the Analysed Literature

After applying the filters described in the previous paragraphs, which resulted in a database of 343 papers, a series of classifications were carried out to ensure a consistent structure for the analysis. A final manual check was also carried out, together with the identification of trends in innovative tools and methods for rainwater harvesting and fog collectors in the construction industry. The final classification of the articles was carried out according to the following three criteria:

1. Progressive definition of an analytically consistent and fully verifiable subset through comprehensive manual checking, while ensuring the feasibility of in-depth analysis.
2. The application of a quantitative support procedure through the use of artificial intelligence (AI) tools, in this case, in the ChatGPT Plus (version 5.2). Using the appropriate prompt, a preliminary pool of 136 papers was identified through a quantitative ranking procedure based on Cosine Similarity. The similarity threshold, ranging from 0 (no relevance) to 1 (maximum semantic relevance), was set to 0.35 to avoid making overly restrictive comparisons between our operative keywords and the titles, abstracts, and keywords of each of the 343 papers. The AI was instructed to provide, year by year, a list of the most relevant papers, assigning them a relevance value of low (≤ 0.25), medium (0.25 to 0.35), or high (> 0.35), while also taking into account the number of citations. The use of a significant number of citations allows papers with greater scientific and academic impact to be considered [32].
3. Qualitative validation through manual checking of the 343 papers. It emerged that the quantitative ranking procedure implemented using Cosine Similarity has variable accuracy from year to year, ranging from a minimum of 25% in 2016 (in red) to a maximum of 100% in 2012, 2018, and 2020 (in green), as shown in Table 2. The overall average accuracy of the AI tool over the period considered was 65%.

Table 2. Accuracy of Cosine Similarity check through AI. Year-by-year value and overall average.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	AVG
Accuracy	100%	67%	100%	50%	75%	50%	25%	50%	100%	75%	40%	50%	76%	59%	59%	65%

Manual re-checking of all 343 papers ensured that the final selection was determined exclusively through independent manual assessment. This procedure verified the relevance of the 136 preliminarily identified papers, correcting AI misclassifications where necessary and replacing them with contributions deemed relevant to the scope of this scoping review.

The re-checking and manual selection process resulted in a final list of 136 papers (see the flowchart in Figure 1) closely related to the topics covered by our scoping review. In this case, since it is a single list that does not result from the union of sets derived from different constraints or keywords, it was not necessary to remove any duplicates.

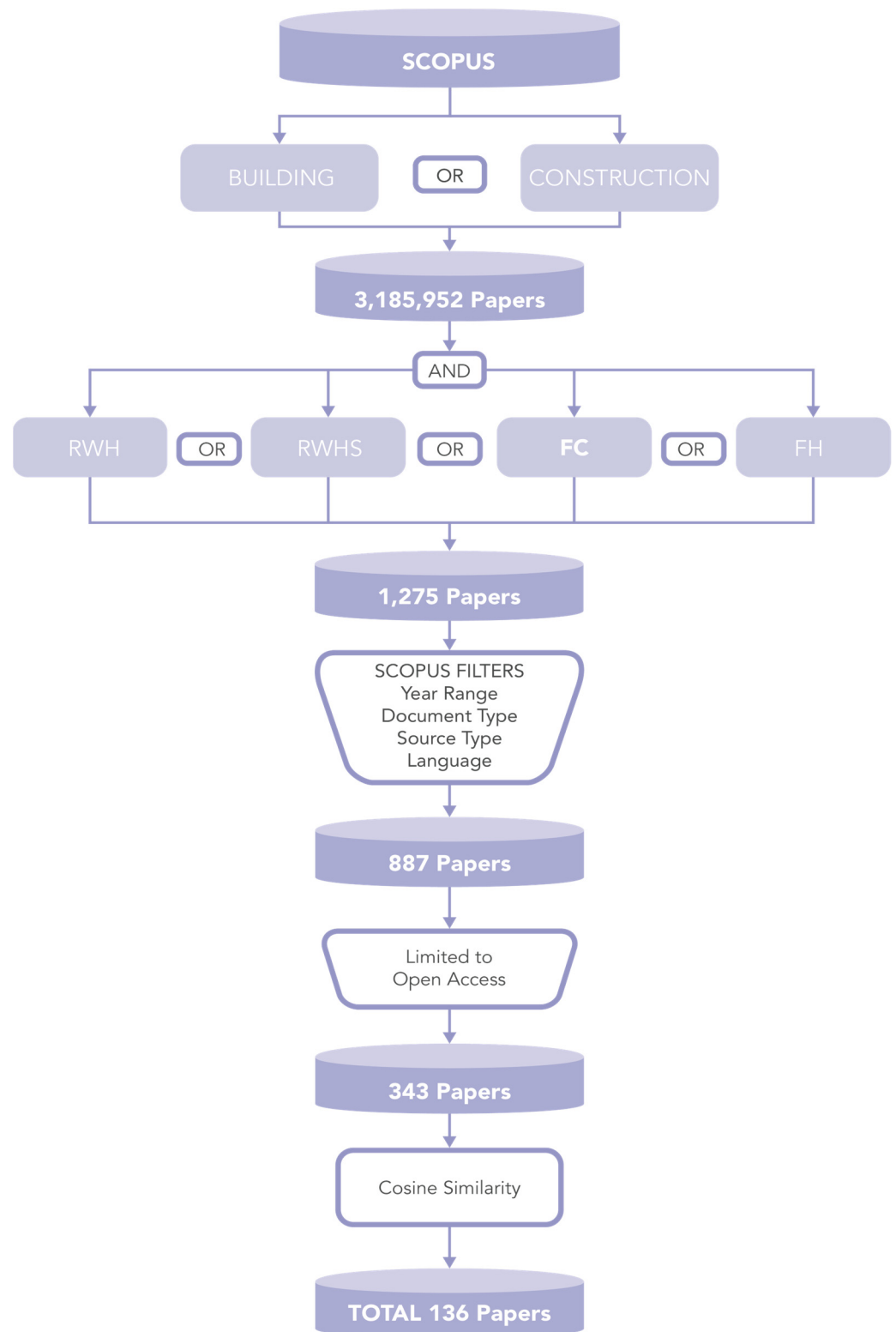


Figure 1. PRISMA-ScR flow diagram to obtain the final list, Appendix A, Table A1 [6,16,23,33–165].

6. Results and Discussion

After narrowing the selection to a final list of 136 papers, they were entered into a dedicated Excel file. This allowed the selected papers and their metadata, retrieved via Scopus, to be isolated. These data supported the further analyses described in this chapter.

6.1. Analysis of the Geographical Distribution of Papers and the Chronological Trend of Publications

This preliminary analysis provides insight into the origins of the researchers' interest, both geographically and chronologically, and how it has developed over time.

As already mentioned in the previous chapter, the publications we are analysing cover the period 2010–2024 (15 years). Over these fifteen years, as shown in Figure 2, interest has grown in a predominantly linear trend, characterised by irregular peaks, with most occurring in the last five years, during which the researchers' interest has doubled.

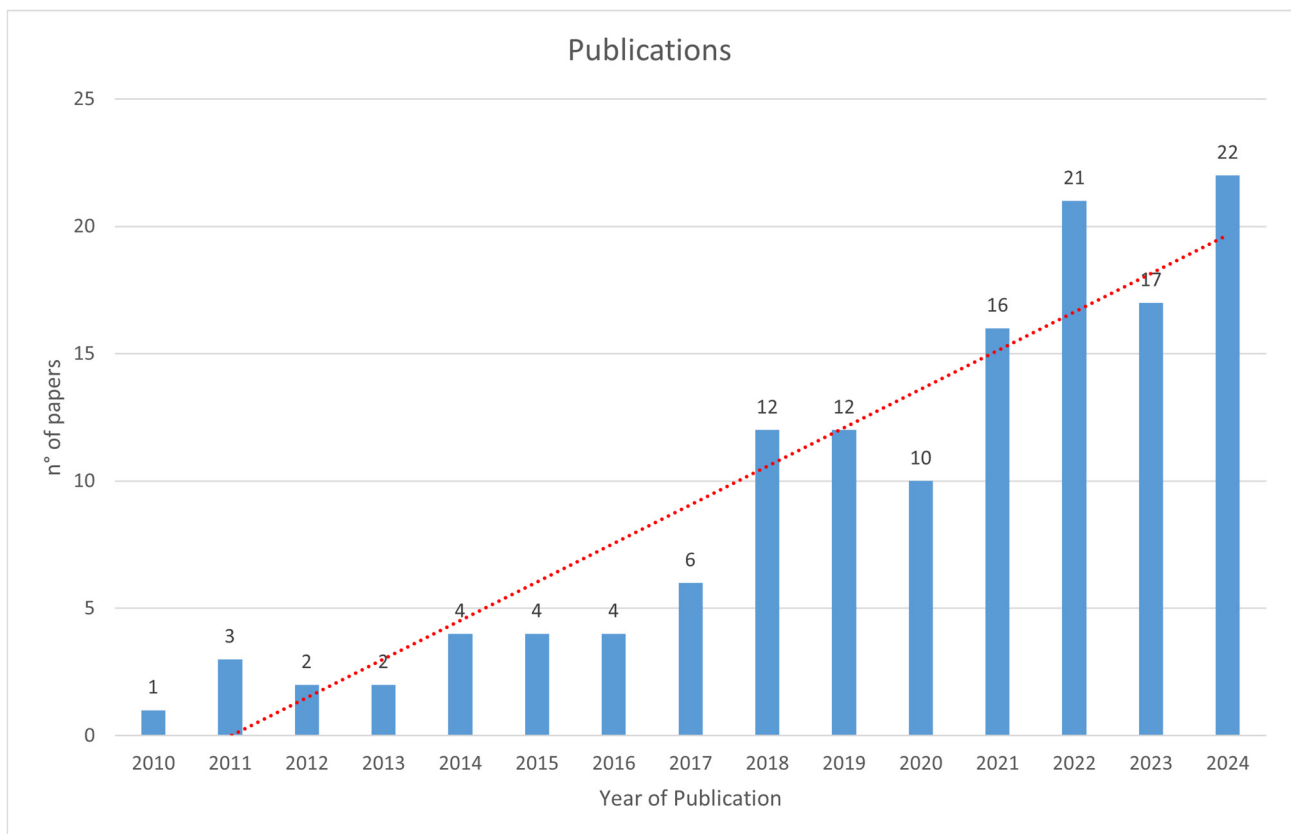


Figure 2. Publication trend from 2014 to 2024. The red dotted line shows the linear regression trend.

To understand the trend in academic interest over the 15 years under review, each researcher involved in the research projects reported in the analysed papers was evaluated. Each paper was then associated with the country of the academic institution to which the researcher belonged. At the country level (see Figure 3), however, researchers from the United States (28) addressed the topic most, followed by researchers from Indonesia (21) and Malaysia (21), both with over 20 researchers involved. Researchers from Spain (19) and China (18), together with those from the United Kingdom, Poland, Italy, Portugal, Turkey, and South Korea, followed with over 10 researchers involved, confirming the continental trend. The pie chart in Figure 4 shows the trend in interest over the period 2010–2024, split by continent. Over the period, on a continental basis, we can see strong interest mainly in Asia and Europe, followed by North America.

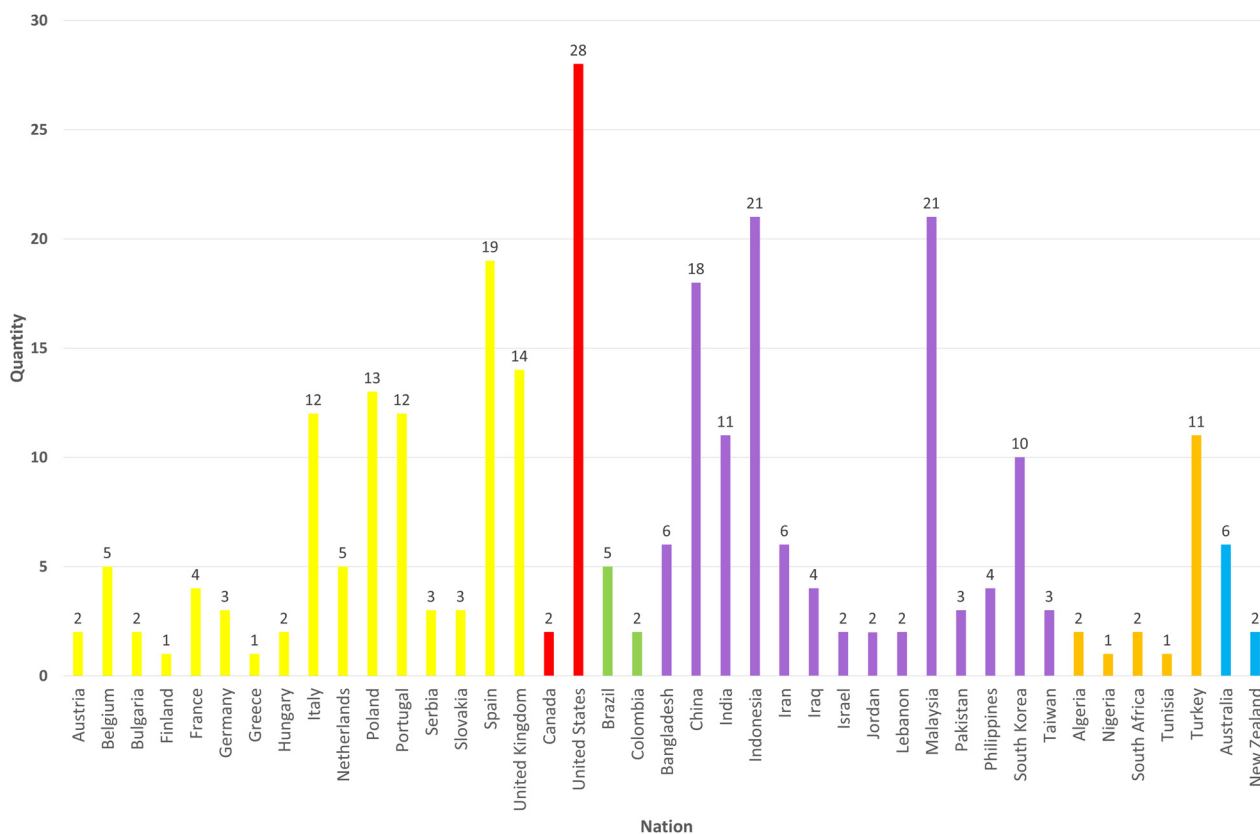


Figure 3. Nations involved (2010–2024).

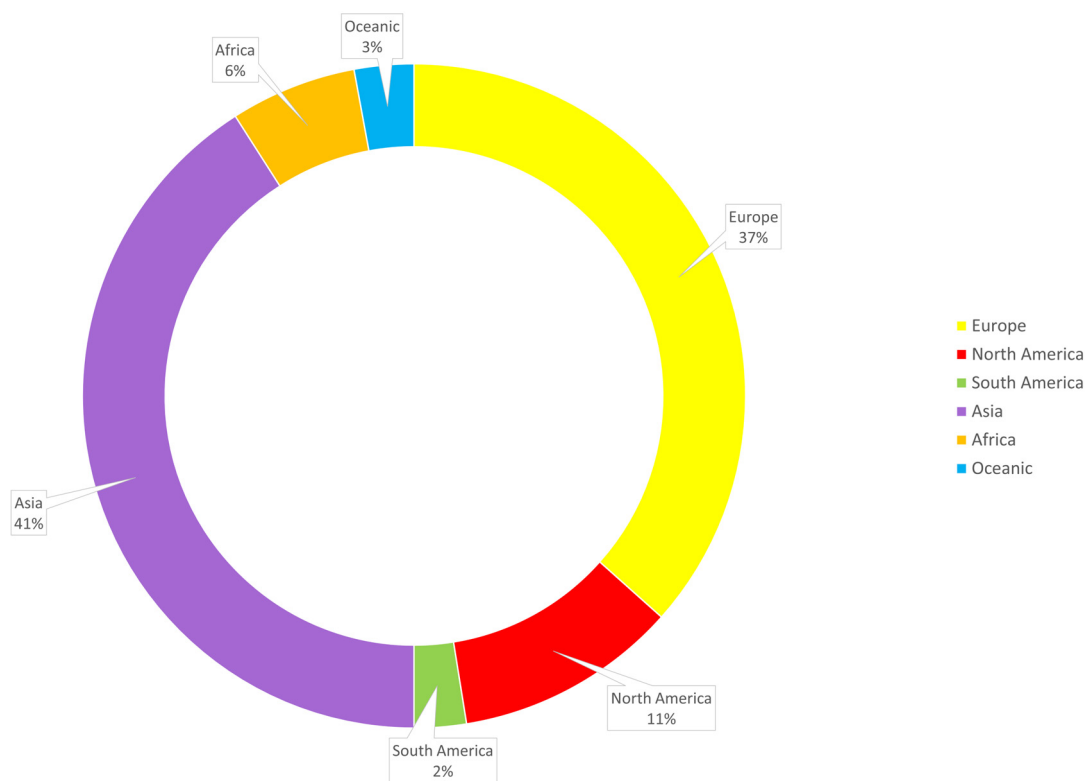


Figure 4. Paper distribution by Continent (2010–2024).

By dividing the analysis into five-year periods, we can see how academic interest has evolved. As shown in Figure 5, interest peaked in Europe (e.g., the United Kingdom, Portugal, Slovakia) and Asia (e.g., Malaysia and South Korea) during the period 2010–2014.

In the following five-year period, 2014–2019, interest stabilised in Europe (e.g., Spain (10), United Kingdom (5)) and Asia (e.g., Indonesia (7), Malaysia (8)). During the same period, it also began to emerge in North America, where the United States (13) stands out (see Figure 6). In the next image (Figure 7), we can see the trend over the last five years, 2020–2024. Europe maintains its linear growth, with greater academic interest in Poland (11), Italy (8), and Spain (8). Asia, thanks to the strong interest shown by China (18) and India (11), as well as the stable presence of Indonesia (14) and Malaysia (8), is seeing an exponential growth in interest. In North America, on the other hand, the United States (14) maintains the same level of interest shown in the previous five years.

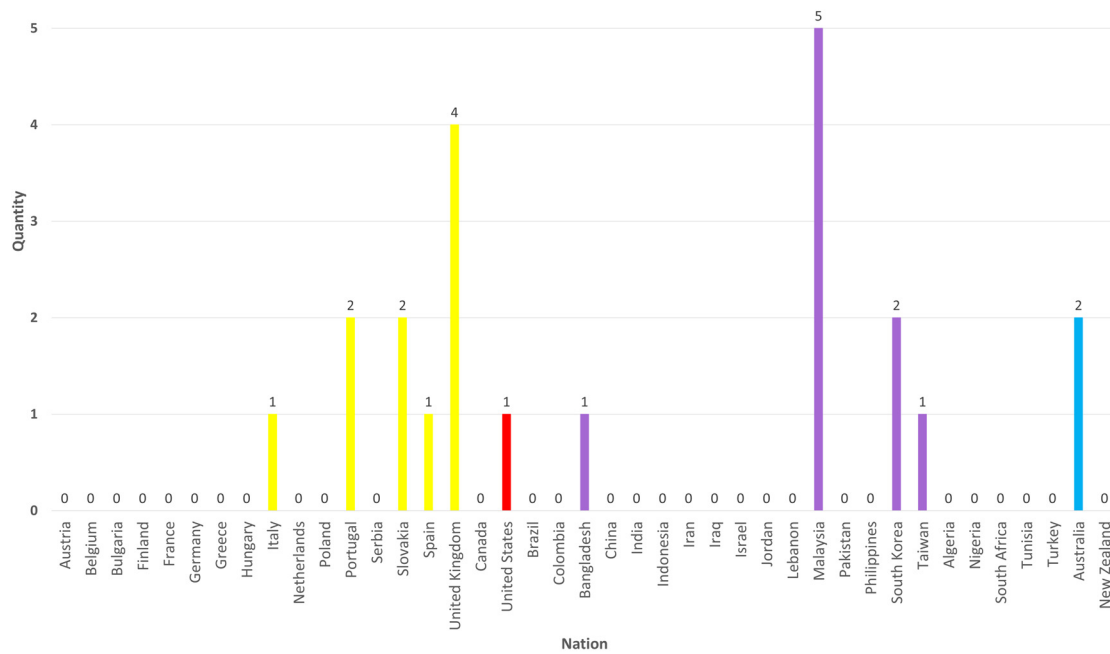


Figure 5. Distribution 2010–2014.

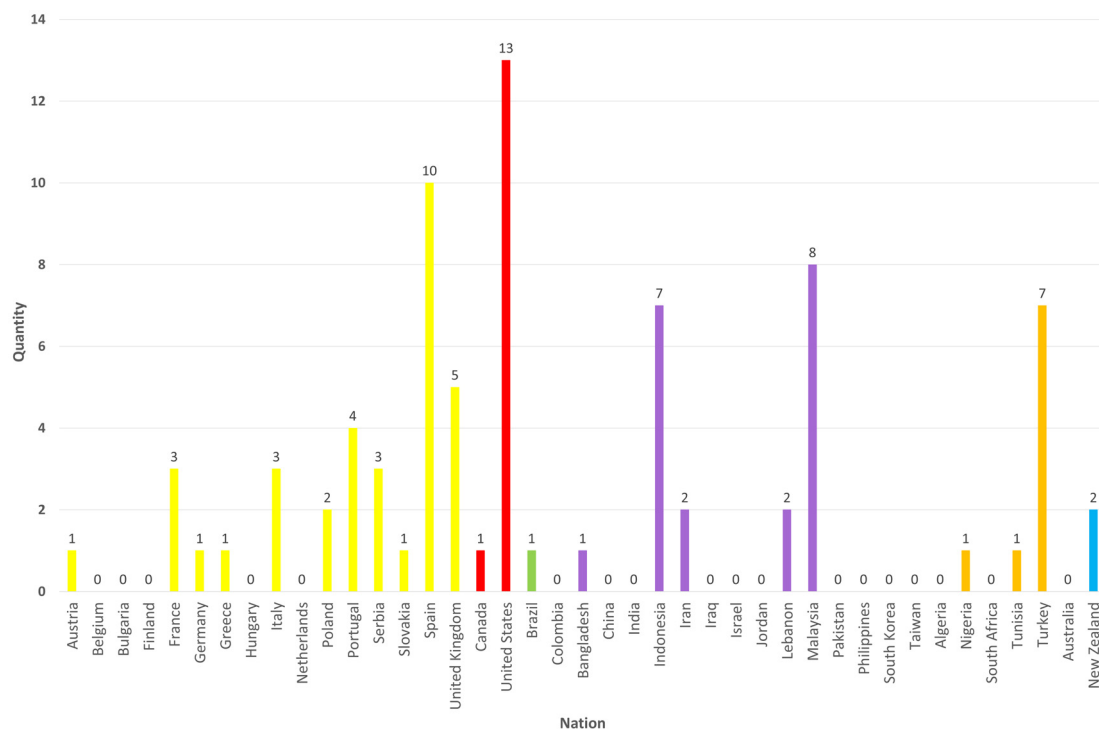


Figure 6. Distribution 2015–2019.

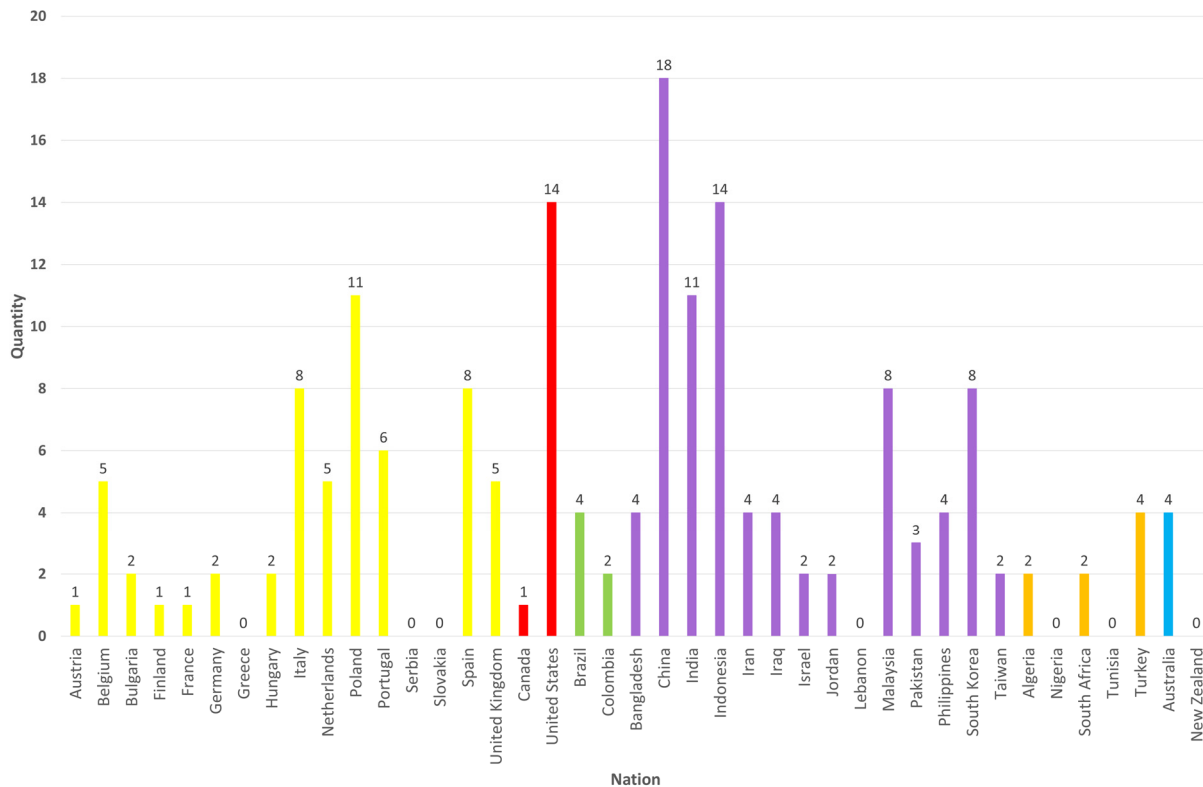


Figure 7. Distribution 2020–2024.

6.2. Analysis of Innovative Technologies

After analysing the geographical distribution of the papers and the trend in interest over the years, the next step is to assess which technologies have been most widely used in water harvesting. The identified technological solutions differ in their collection principles and areas of application. Rainwater harvesting systems (RWHSs) catch and store rainfall running off building surfaces. They typically use components such as gutters and storage tanks, and are widely used in urban environments due to their relatively high efficiency and their potential for architectural integration. On the other hand, fog harvesting systems rely on passive mesh collectors that capture humidity from the air. For this reason, they are particularly suitable for open regions characterised by frequent fog, such as arid and coastal areas. While RWHSs represent a mature and widely implemented solution, fog harvesting technologies offer complementary opportunities under specific climatic conditions, although their performance depends strongly on local environmental factors. Even without providing a quantitative comparison of the performance of the various systems examined, the mapping highlights how the effectiveness of different technologies is strongly context-dependent, especially in terms of climatic conditions, scale of application, and integration strategies.

In this case, the analysis was conducted in three steps.

In the first step, each abstract was analysed to identify sections of text characterised by the following three topics: Technology, Location, and Aim.

The second step involved an in-depth analysis of the findings for each of the three items, dividing them as follows:

- Technology, considered as follows:
 - Main Technology
 - Secondary Technology
 - Integrated Technology
 - Digital Tool

- Location where the technology is applied, as follows:
 - Level 1—Scale/Context
 - Level 2—Physical location/Building Element
- Aims for water harvesting, as follows:
 - Primary Aim
 - Secondary Aim

By carrying out this detailed study, the amount of data to be considered increases, allowing analyses that include more aspects of each item analysed; however, the data remains raw and unsuitable for comparison. For this reason, a third step was necessary, during which the extrapolated data were normalised and structured. This procedure collected, using a controlled vocabulary, all similar items that would otherwise be counted as unique data, making comparisons and classifications impossible.

The items in the various normalisation vocabularies were not considered mutually exclusive categories but rather multi-response variables.

Papers dealing with multiple entries were therefore counted for each relevant entry. As a result, the percentages refer to the proportion of studies that dealt with a given entry and do not add up to 100%. This approach was consistently applied across all subsequent analyses, including technologies, scales of application, physical locations, and research objectives.

6.2.1. Normalisation with Respect to the Technology's Topic

The technologies identified in the literature operate at different scales and levels of integration, ranging from material-based solutions to system-level configurations. To clarify their respective roles and to relate the classification adopted in this study (MT, ST, IT, DT) to their functional contribution within building-scale water management, a synthetic mapping of the main terms and technologies is provided.

In analysing the Main Technologies (MT) used, normalisation enabled the classification of the various entries across the 136 articles into a controlled vocabulary of seven categories. The classification spans multiple levels of abstraction, from material-based solutions (MT3) to system-scale infrastructures (MT6–MT7), reflecting the heterogeneity of the approaches identified in the literature. To provide a clearer technical interpretation of the classification adopted in this study, Table 3 summarises the Main Technologies (MT) identified in the literature, linking each category to its hydrological function, operational principle, and role within building-scale water management systems.

This step, as shown in Figure 8, enabled the identification of the most commonly used technologies in the examined articles. In cases where multiple technologies were found simultaneously, and it was not possible to identify the main one, it was decided to report the category as the sum of the identified technologies (e.g., MT4 + MT5 + MT7, MT4 + MT7).

In the same figure, it can be seen that the most widely used Main Technology is MT4, cited in 83% of the papers, rising to 88% when we also include the cases where it was not possible to define a single Main Technology. In second place, albeit with a clear gap, stands the MT2 category, which accounts for 6%. The remaining technologies, on the other hand, account for between 1% and 2%.

In addition, an analysis of the abstracts of the selected papers revealed that 61% of the papers are combined with a Secondary Technology (ST), while an Integrated Technology (IT) occurs in only 25% of cases. On the other hand, 18% of the papers analysed use a Digital Tool (DT).

Table 3. Functional mapping of the Main Technologies (MT).

MT Code	Technology Category	System Scale	Hydrological Function	Operational Principle	Role Within Building Water System
MT1	Filtration System	Component/ Building	Water quality control	Physical, biological, or chemical removal of contaminants (e.g., sedimentation, membrane filtration)	Enables safe reuse by conditioning harvested water for intended end-use (non-potable or potable)
MT2	Fog Harvesting System	Building/ Façade/Site	Atmospheric water capture	Condensation of airborne moisture on mesh or surface collectors under specific climatic conditions	Provides supplementary water source in fog-prone regions, independent of rainfall
MT3	Rainwater Construction Material	Material/ Element scale	Storage & infiltration	Use of permeable or porous materials (e.g., sponge concrete) to absorb and temporarily store water	Enhances decentralised retention and reduces runoff at surface level
MT4	Rainwater Harvesting System (RWHS)	Building	Collection & storage	Capture of roof runoff via drainage systems and storage in tanks or cisterns	Primary system for on-site water supply substitution (non-potable uses)
MT5	Stormwater Harvesting System	Site/Urban	Runoff control & storage	Collection and detention of surface runoff from impervious areas	Reduces peak discharge and enables reuse at larger spatial scales
MT6	Urban Water Management System	Urban/District	Integrated water cycle management	Combination of decentralised systems (green–blue infrastructure, storage, reuse networks)	Coordinates multiple flows (rainwater, greywater, stormwater) at urban scale
MT7	Wastewater Management System	Building/ District	Treatment & reuse	Treatment of greywater/blackwater through mechanical, biological, or hybrid processes	Closes water loop by enabling internal reuse and reducing freshwater demand

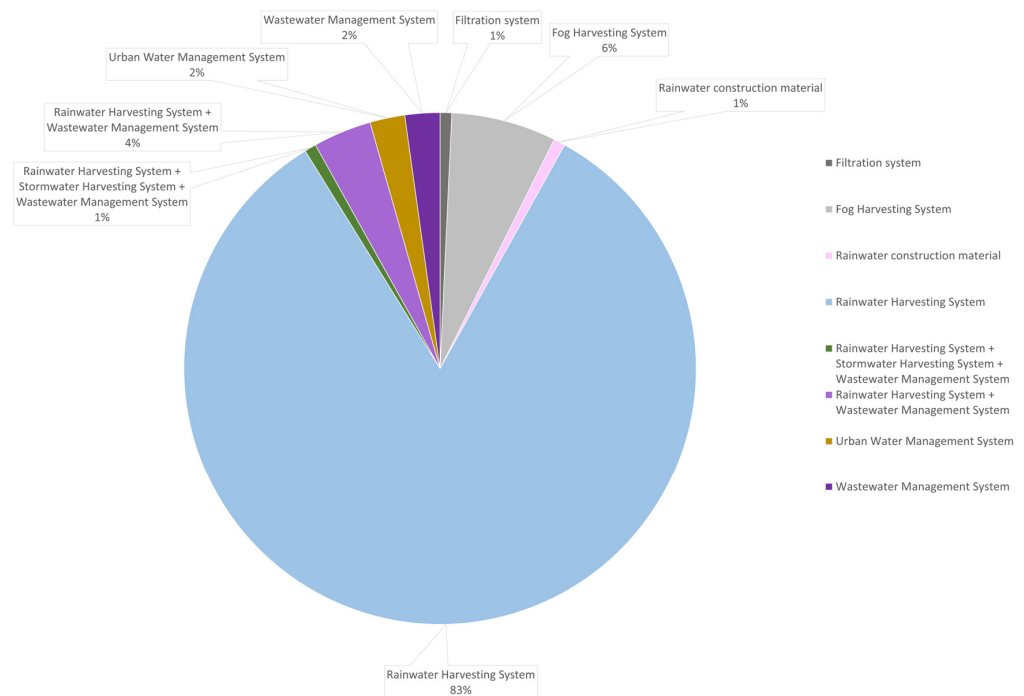


Figure 8. Analysis of the Main Technologies.

It should be noted that, in the classification phase for ST, IT, and DT, all items were treated as technological solutions, even when expressed through building elements (e.g., roof, wall), since the distinction between technology and physical location had already been made in the initial extraction phase.

Given that, based on the MT analysis, MT4 was found to be predominant, representing over 80% of the corpus analysed, a further assessment of technological complexity was carried out exclusively within this main category (see Figure 9). The MT4 subset was then normalised and subsequently disaggregated by the presence and combination of STs, ITs, and DTs, allowing for the number and type of technological configurations associated with MT4 to be mapped without introducing over-representation or bias across the categories.

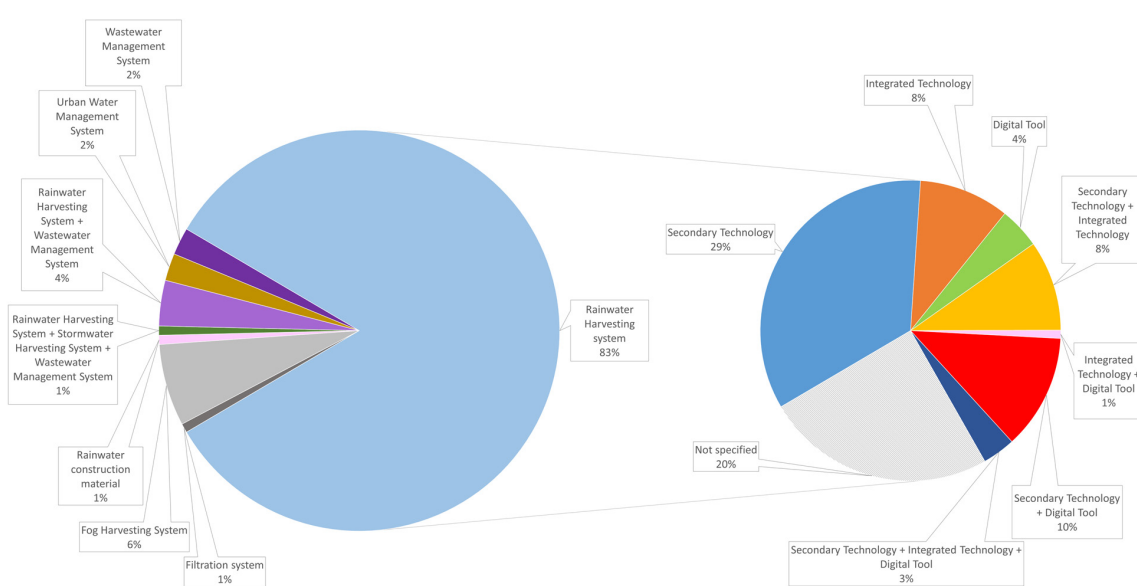


Figure 9. Detail of RWHS.

As shown in Figure 10, the set of papers characterised by MT4 can be broken down into STs (34%), ITs (10%), DTs (4%), and their combinations (27%).

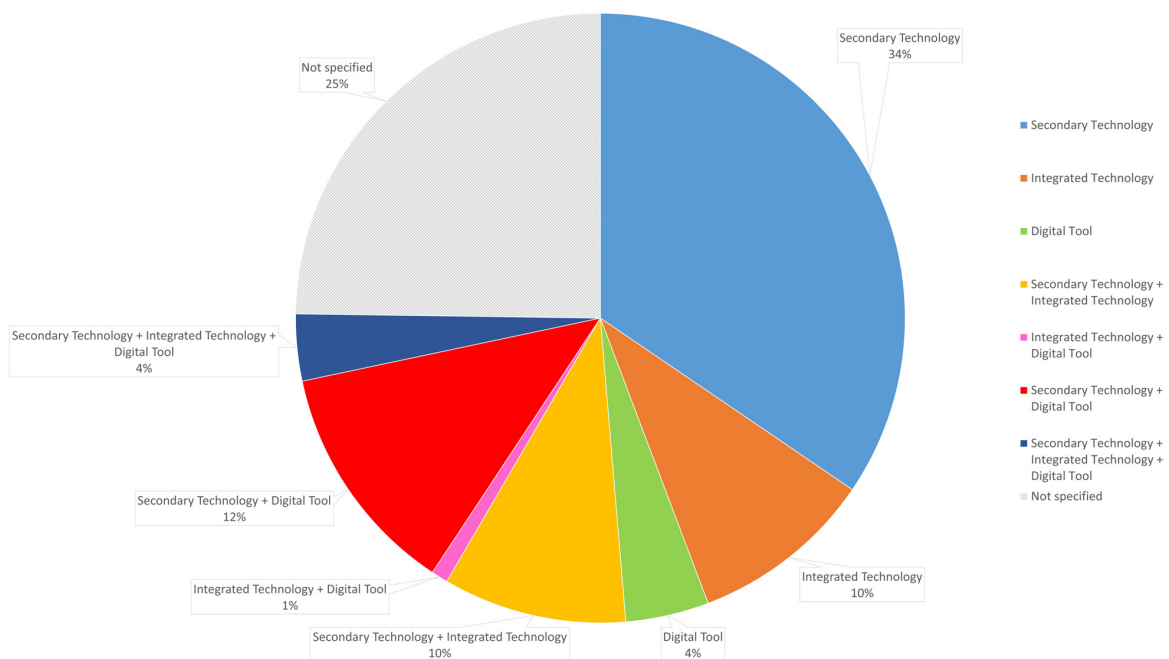


Figure 10. Presence of other technologies or combinations thereof.

Going into even greater detail and considering only the 113 papers characterised by the use of MT4—the light blue section of the primary pie chart in Figure 9—it was possible to analyse them and highlight the different relationships with other technologies.

Secondary Technologies (STs) are components or subsystems that support or enhance the performance of the main water-harvesting system. Unlike Main Technologies, Secondary Technologies are not standalone systems but functional components that contribute to specific phases of the water harvesting process (collection, storage, treatment, or control).

Specifically, the 68 papers in which the MT is accompanied by an ST were analysed by normalising the data using the following vocabulary. Table 4 provides a functional mapping of these elements, clarifying their role within the overall hydrological process and their contribution to building-scale water management.

Table 4. Functional mapping of Secondary Technologies (STs).

ST Code	Technology Category	System Scale	Hydrological Function	Operational Principle	Role Within Building Water System
ST1	Roof-based collection system	Building (roof)	Collection	Interception and conveyance of precipitation via roof geometry, slope, and drainage elements	Defines primary catchment efficiency and initial water quality
ST2	Wall-based collection system	Building envelope (façade/wall)	Collection	Vertical interception of rainwater or wind-driven precipitation, in some cases, fog condensation	Supplements horizontal catchment, particularly in dense or vertical urban morphologies
ST3	Storage system	Building/Site	Storage	Temporary accumulation of collected water in tanks, cisterns, or modular systems	Balances the temporal mismatch between supply and demand
ST4	Filtration/treatment component	Component/Building	Water quality control	Removal of suspended solids, organic matter, and contaminants through physical or biological processes	Enables safe reuse for specific end uses (e.g., irrigation, flushing)
ST5	Monitoring, sensing & control system	Building/System	Regulation & optimisation	Use of sensors, control logic, and automation to monitor flows, storage levels, and quality	Improves operational efficiency and system reliability
ST6	Green roof system	Building (roof)	Retention, delay, & evapotranspiration	Vegetated multilayer system that absorbs, stores, and gradually releases rainwater	Reduces runoff, enhances retention, and provides co-benefits (thermal, ecological)
ST7	Not specified	—	—	—	Category used when insufficient technical detail is provided in the source literature

This analysis revealed that ST1 (38) and ST3 (32) are the two most common Secondary Technologies (see Figure 11).

Integrated Technologies differ from Main and Secondary Technologies in that they do not represent discrete physical systems, but coordinated configurations that link multiple components across scales. For the 27 papers in which the Main Technology is combined with an Integrated Technology, the data were analysed using a specific normalised vocabulary.

Integrated Technologies (ITs) refer to system-level configurations that combine multiple components or processes to manage water flows across building and urban scales. Table 5 summarises these technologies by linking each category to its hydrological function, operational principle, and role within integrated water management strategies.

This analysis revealed that IT1 (9) is the most widely used category of ITs, followed by IT2 (5), IT3 (4), and IT4 (4) (see Figure 12).

The final item analysed is the presence of Digital Tools. This category does not constitute physical water harvesting technologies but provides the computational and data-driven framework necessary for their design, evaluation, and operational control.

With regard to the 24 papers in which the MT is combined with a DT, the data were analysed using a specific normalised vocabulary: Digital Tools (DTs) represent analytical and

computational instruments that support the design, simulation, optimisation, and operation of water-harvesting systems. Table 6 summarises these tools by linking each category to its functional role within the modelling and management of building-scale water systems.

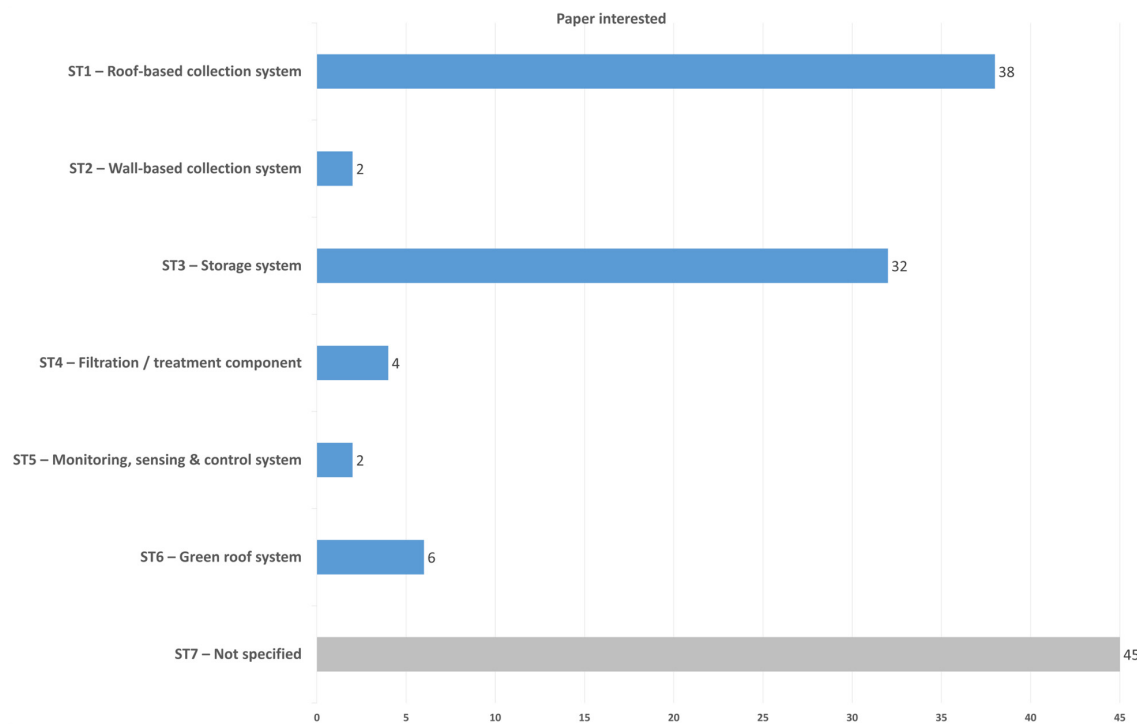


Figure 11. Main Technologies with Secondary Technologies.

Table 5. Functional mapping of Integrated Technologies (ITs).

IT Code	Technology Category	System Scale	Hydrological Function	Operational Principle	Role Within Building Water System
IT1	Water Reuse & Recycling Systems	Building/District	Demand reduction & reuse	Collection, treatment, and redistribution of greywater or harvested water for non-potable uses	Reduces reliance on potable supply by closing internal water loops
IT2	Stormwater Management & Regulation Systems	Site/Urban	Runoff attenuation & flow regulation	Detention, retention, and controlled release of stormwater via basins, tanks, or distributed systems	Mitigates flooding risk and stabilises hydraulic loads on drainage infrastructure
IT3	Groundwater Interaction Systems	Site/Subsurface	Infiltration & aquifer recharge	Managed percolation of collected water into the ground through infiltration systems	Enhances groundwater recharge and reduces surface runoff volumes
IT4	Green-Blue Infrastructure Systems	Urban/District	Multifunctional retention, treatment & evapotranspiration	Integration of vegetated and water-based systems (e.g., wetlands, green corridors) to manage water flows	Provides ecosystem-based water management with co-benefits (cooling, biodiversity, water quality improvement)
IT5	Smart Control & System Coordination	Building/Network	System optimisation & dynamic control	Use of sensors, data acquisition, and control algorithms to coordinate multiple subsystems	Enables adaptive management and improves the efficiency of integrated water systems
IT6	Energy & Environmental Integrated Systems	Building/District	Resource coupling & efficiency	Integration of water systems with energy or environmental systems (e.g., heat recovery, cooling)	Enhances overall building performance through water-energy-environment synergies
IT7	Not specified	—	—	—	Category used when insufficient technical detail is provided in the source literature

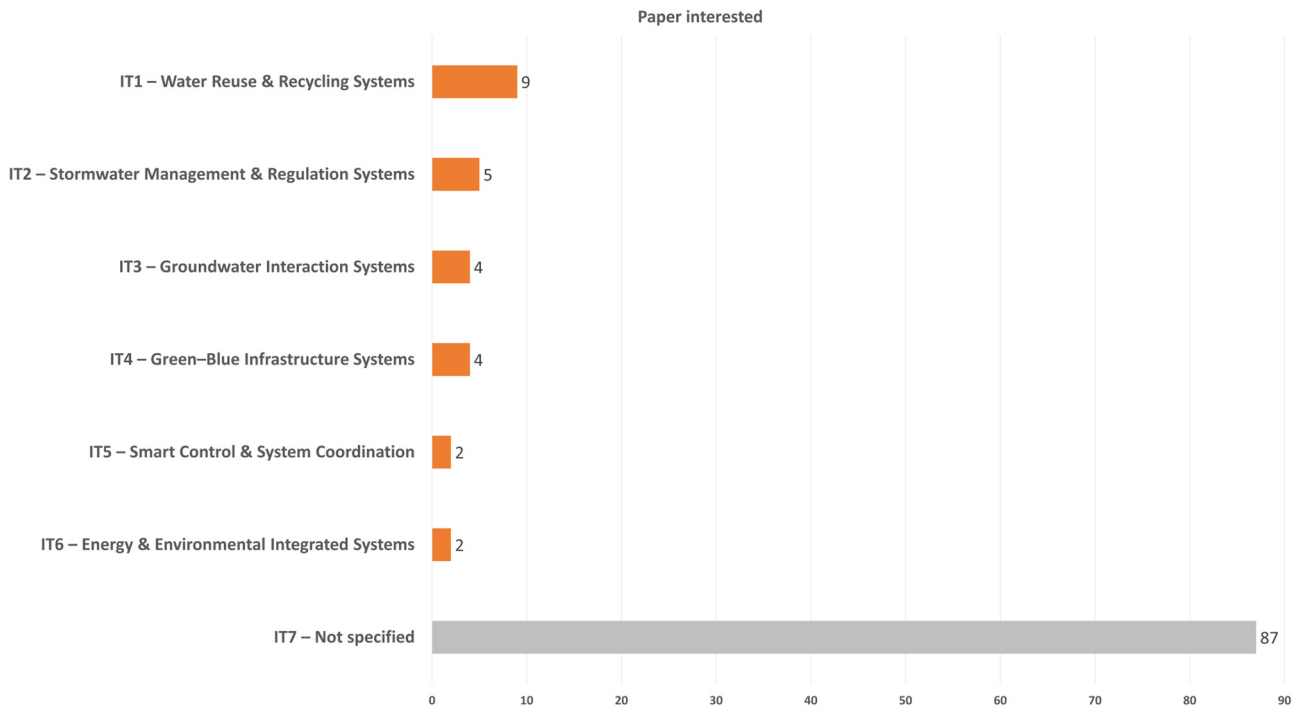


Figure 12. Main Technologies with Integrated Technologies.

Table 6. Functional mapping of Digital Tools (DTs).

DT Code	Technology Category	System Scale	Hydrological Function	Operational Principle	Role Within Building Water System
DT1	GIS & Geospatial Analysis Tools	Site/Urban/Regional	Spatial assessment & resource mapping	Use of georeferenced datasets to analyse rainfall distribution, catchment characteristics, and site suitability	Supports site selection, scalability assessment, and spatial optimisation of water harvesting systems
DT2	Hydraulic & Hydrological Modelling Tools	Building/Site/Urban	Flow simulation & system sizing	Numerical modelling of rainfall–runoff processes, storage dynamics, and drainage behaviour	Enables dimensioning of tanks, pipes, and system components under varying conditions
DT3	Simulation & Computational Modelling	Building/System	Performance prediction	Computational simulations (e.g., parametric, stochastic) to evaluate system behaviour over time	Assesses efficiency, reliability, and sensitivity to climatic variability
DT4	BIM & Digital Building Modelling	Building	System integration & design coordination	Digital representation of building components and systems within an integrated modelling environment	Facilitates coordination between architectural, structural, and water systems during design
DT5	Monitoring, Sensors, & Smart Systems	Building/System	Real-time data acquisition & feedback control	Deployment of sensors to track flow rates, storage levels, and water quality parameters	Enables operational monitoring, fault detection, and adaptive management
DT6	Decision Support & Performance Evaluation Tools	Building/Urban	Optimisation & decision-making	Multi-criteria analysis, optimisation algorithms, and evaluation frameworks	Supports selection of optimal configurations based on technical, economic, and environmental criteria
DT7	Not specified	—	—	—	Category used when insufficient technical detail is provided in the source literature

This analysis revealed that DT6 (7) and DT1 (6) are the most widely used DT categories (see Figure 13).

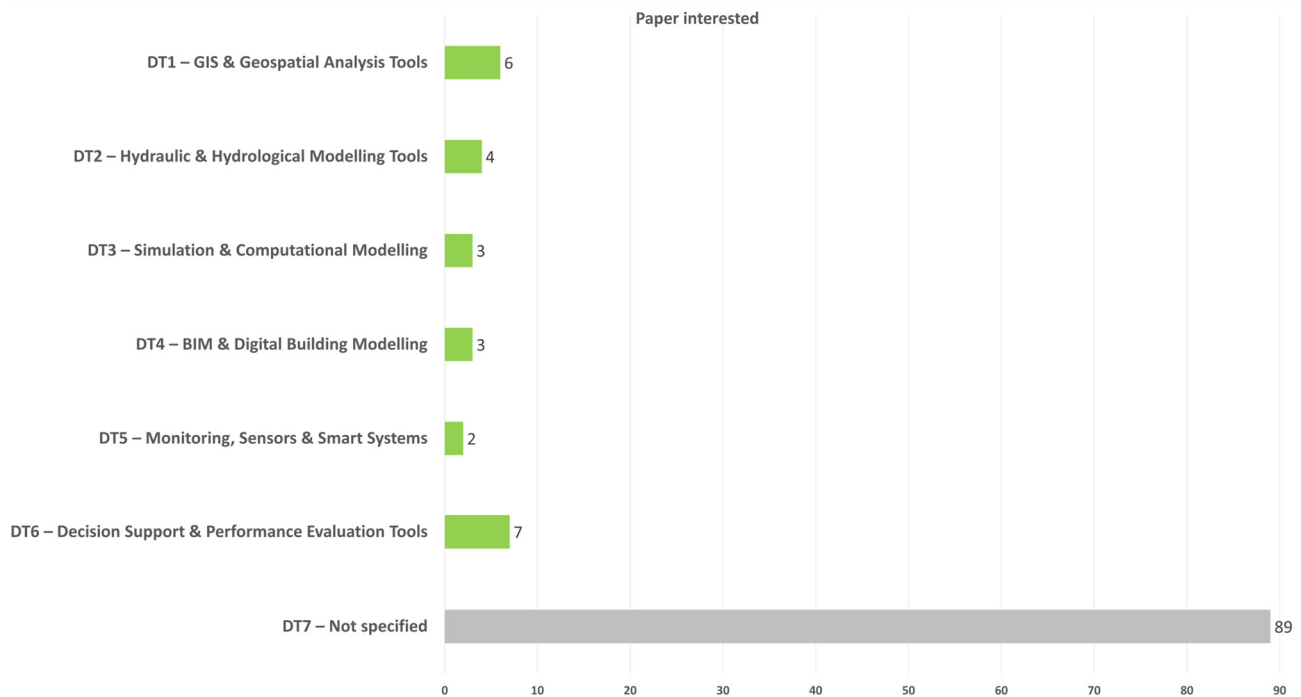


Figure 13. Main Technologies with Digital Tools.

The figures indicate the percentage of articles in which each DT is present. The values do not add up to 100% because of the multi-response nature of the data.

6.2.2. Normalisation with Respect to the Location's Topic

The term “Location” was used as a macro-category indicating the place where technologies are applied. Normalisation was split into the following two levels: the Scale/Context of application and the specific Building Element/Physical Location involved. Two distinct vocabularies were used to analyse the topic of Location.

The first, useful for outlining the Scale/Context of application (SC) of the technologies previously identified, consists of the following six items:

1. Building-scale (SC1)
2. Site-scale (SC2)
3. Urban-scale (SC3)
4. Regional-scale (SC4)
5. Subsurface (SC5)
6. Not specified (SC6)

As shown in Figure 14, 74% of the 136 selected papers focus on SC1. This percentage can reach 84% if we also include the papers that address multiple application scales simultaneously (e.g., SC1 + SC2, SC1 + SC3, SC1 + SC5). Continuing the analysis, we can see that the scale of application extends to SC3, ranking second with 7% of the papers examined. In this case, considering also papers that address SC3 alongside other scales of application (e.g., SC3 + SC5, SC1 + SC3, SC2 + SC3), the value reaches 14%. The other SCs, on the other hand, do not exceed 8% altogether.

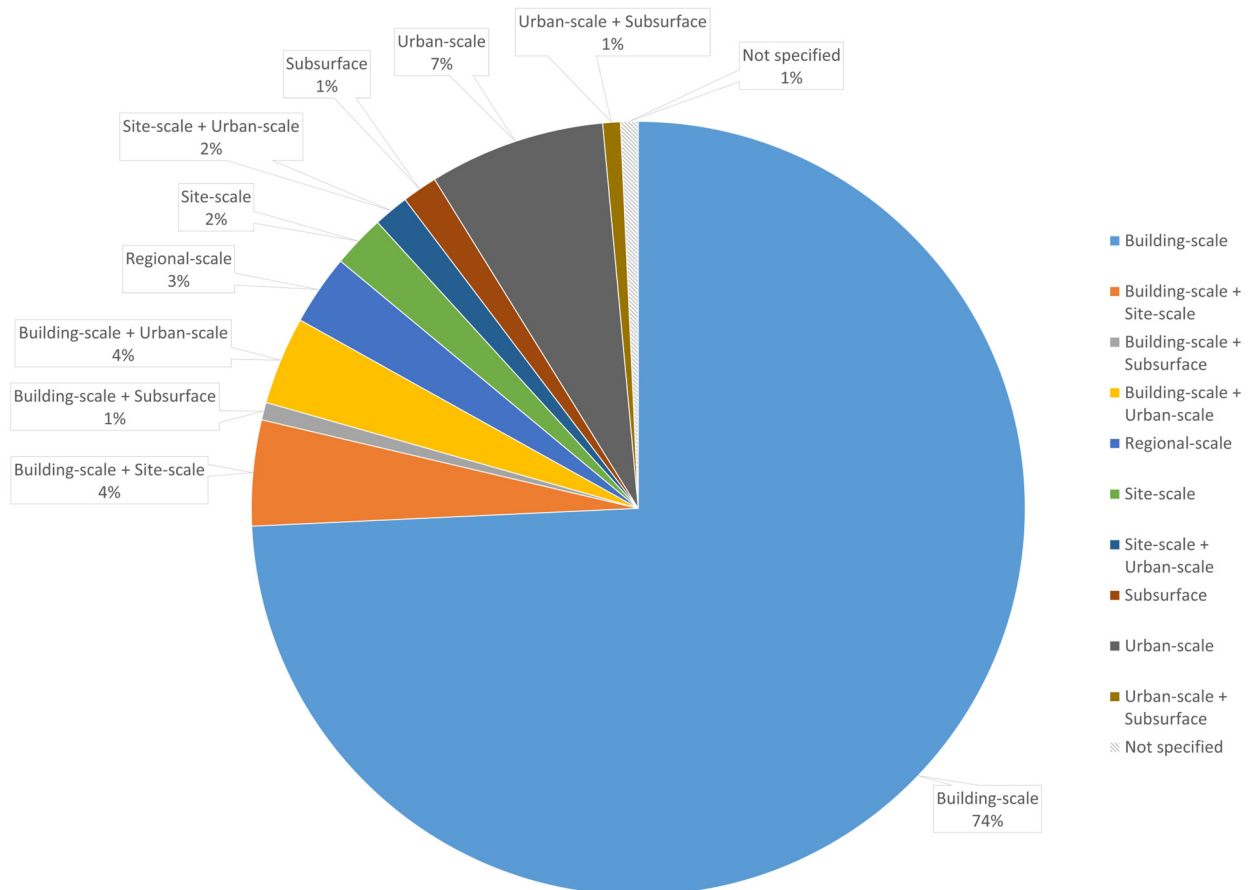


Figure 14. Analysis of Scale/Context location.

The second vocabulary, on the other hand, was used to highlight the Building Element/Physical Location involved (BL) or the elements where water harvesting technologies are applied, as follows:

1. Ground (BL1)
2. Pipe (BL2)
3. Internal hydraulic surface (BL3)
4. Pavement (BL4)
5. Green roof (BL5)
6. Roof (BL6)
7. Tank (BL7)
8. Façade (BL8)
9. Living façade (BL9)
10. Wall (BL10)
11. Urban green infrastructure (BL11)
12. Not specified (BL12)

As shown in Figure 15, excluding the 35% of papers in which the Building Element/Physical Location of application is BL12 (Not Specified), 26% of the analysed papers report that the technologies are applied to the “Roof” (BL6). This category can reach 36% if we also consider the particular situations in which, in addition to BL6, multiple locations or elements of application were found in the paper (e.g., BL6 + BL1, BL6 + BL4, BL6 + BL2, BL6 + BL7). The BL5 category alone accounts for only 1% of papers, but can reach 5% if we also consider papers that use it alongside other applications (e.g., BL5 + BL7, BL5 + BL9, BL5 + BL4 + BL11).

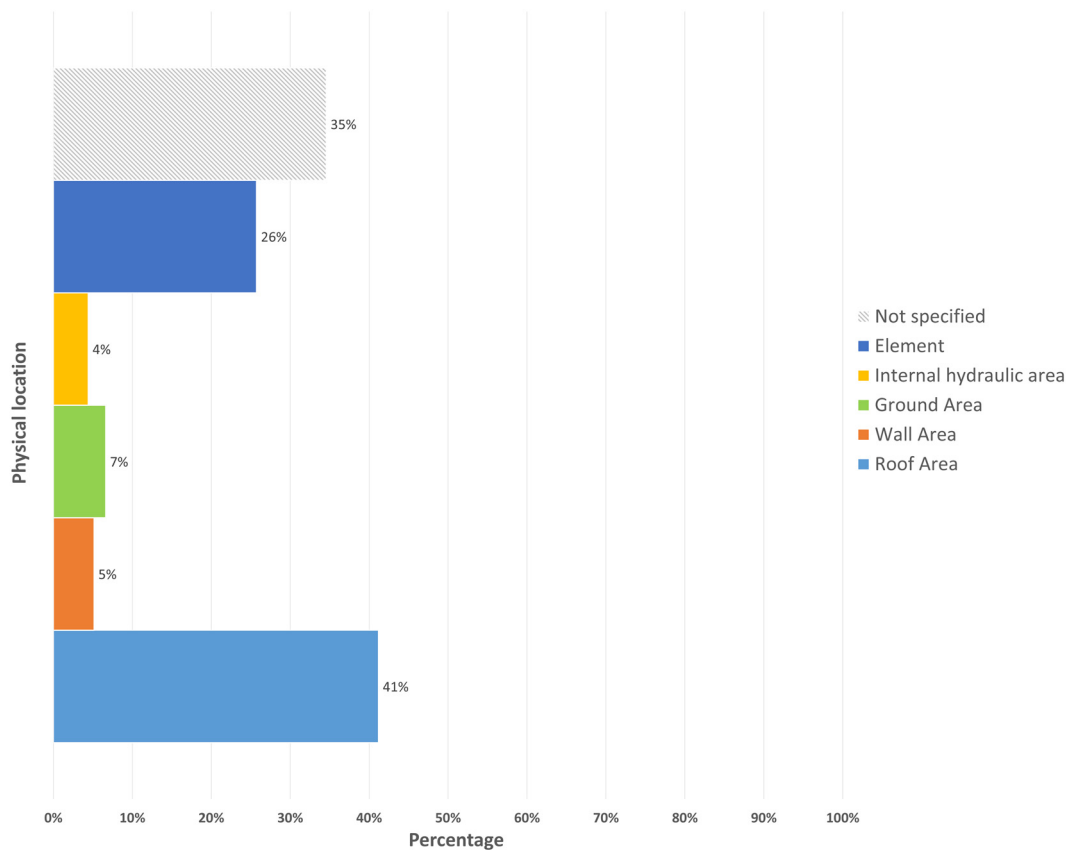


Figure 16. Percentage of papers in which each Physical location is present.

6.2.3. Normalisation with Respect to the Aim's Topic

A single vocabulary was used to analyse the primary and secondary aims described and pursued in the 136 papers, with the addition of the category "Not specified" to indicate the absence of secondary objectives.

The 10 + 1 categories used to standardise the analysis of the Aims (AM) are as follows:

1. Alternative and Supplementary Water Supply (AM1)
2. Climate Change Adaptation and Resilience (AM2)
3. Decentralised, Urban and Social Water Systems (AM3)
4. Energy and Economic Performance (AM4)
5. Environmental and Resource Sustainability (AM5)
6. Non-Potable Water Reuse (AM6)
7. Potable Water Quality and Treatment (AM7)
8. Stormwater and Flood Management (AM8)
9. System Design, Integration, and Performance (AM9)
10. Water Conservation and Efficiency (AM10)
11. Not Specified (A11)

Figures 17 and 18 show the percentages of AMs identified in the papers, normalised according to the defined vocabulary. The three categories that emerge as primary aims are AM9, AM6, and AM10, with values of 16%, 15%, and 14%, respectively, while the other categories remain below 10%.

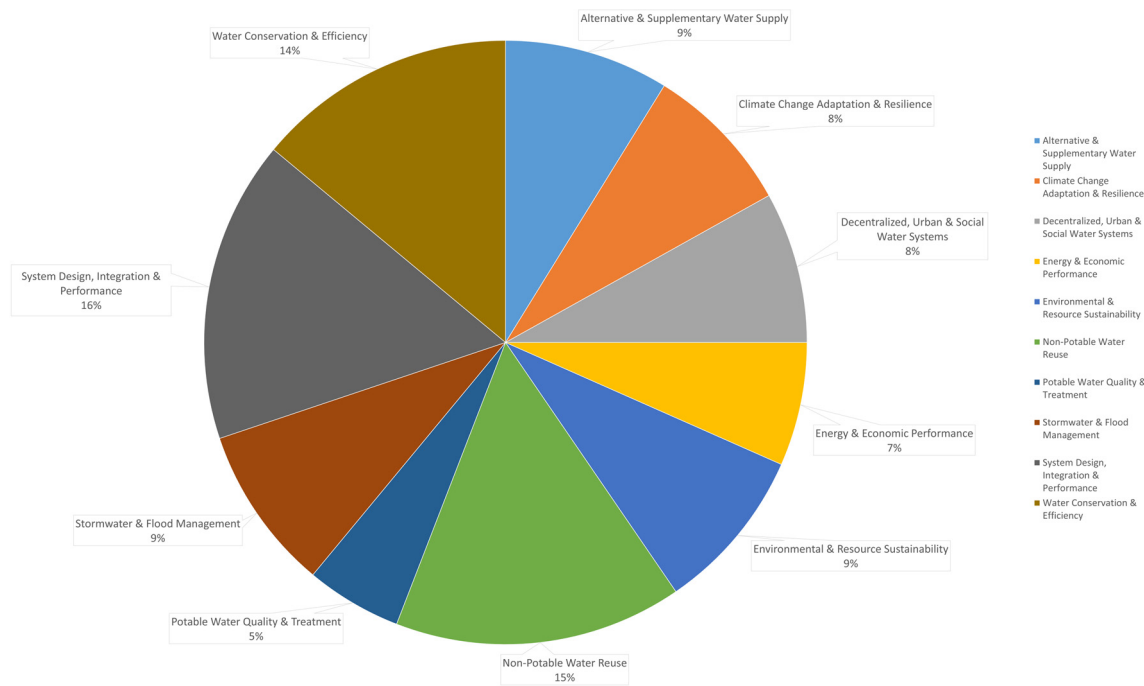


Figure 17. Analysis of the Primary Aims.

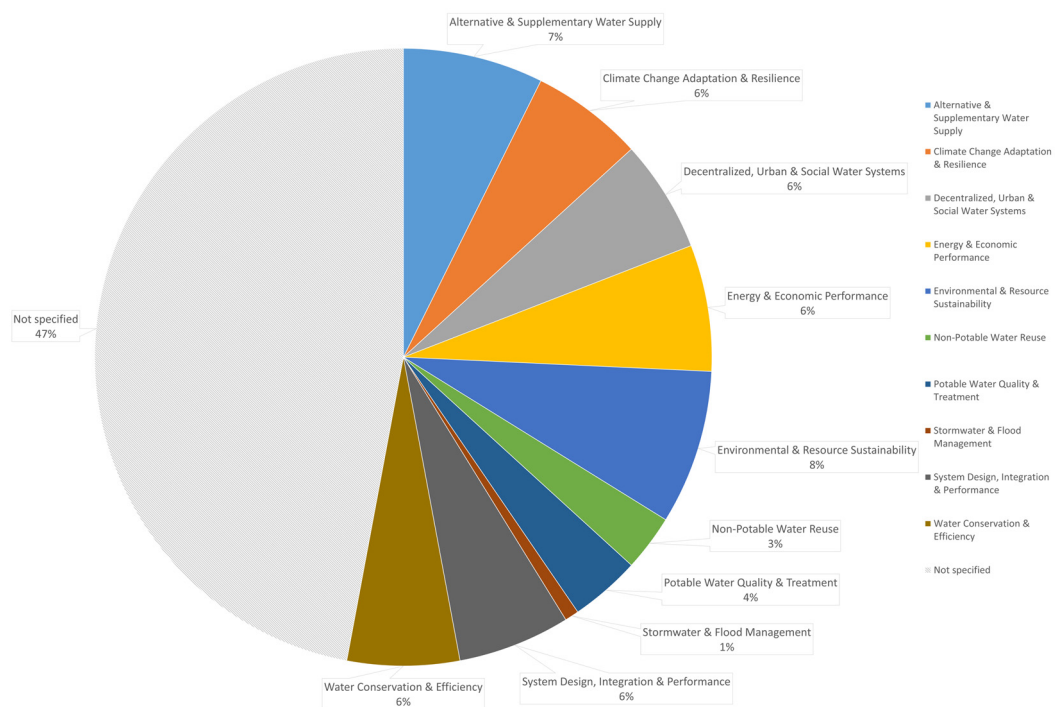


Figure 18. Analysis of the Secondary Aims.

A total of 53% of the papers analysed include a secondary aim. Among these, the normalised categories AM5 and AM1 are slightly more prevalent, at 8% and 7%, respectively. The other categories, on the other hand, range from 1% to 6%.

6.2.4. Focus on Case Studies Implementation and Distribution

After analysing all 136 selected papers, the next step is to examine in detail those that present projects supported by case studies.

As shown in Figure 19, 53 of the 136 selected papers (about 40%) feature a case study.

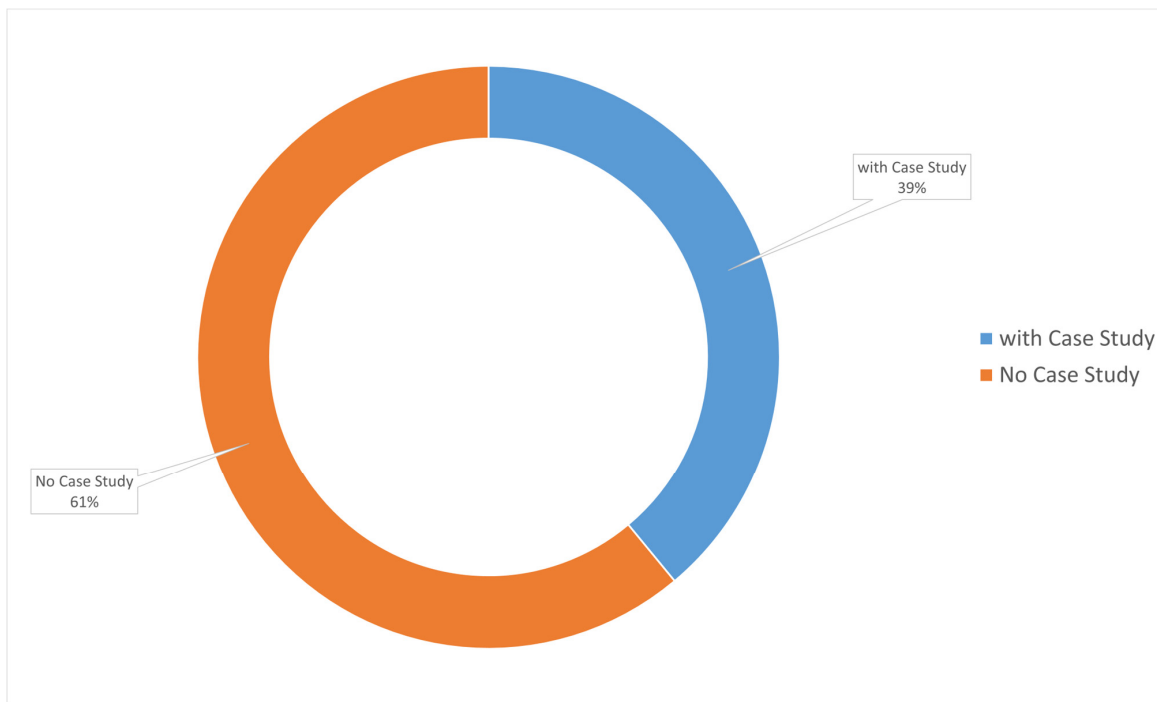


Figure 19. Distribution of Case Studies in the analysed papers.

Once the number of papers characterised by case studies had been identified, an analysis was conducted to determine where these case studies on water harvesting technologies had been most widely applied.

At the continental level (see Figure 20), the analysis showed that most case studies were applied in Asia (51%) and Europe (26%). The other continents share the remaining papers (4–7%) almost equally.

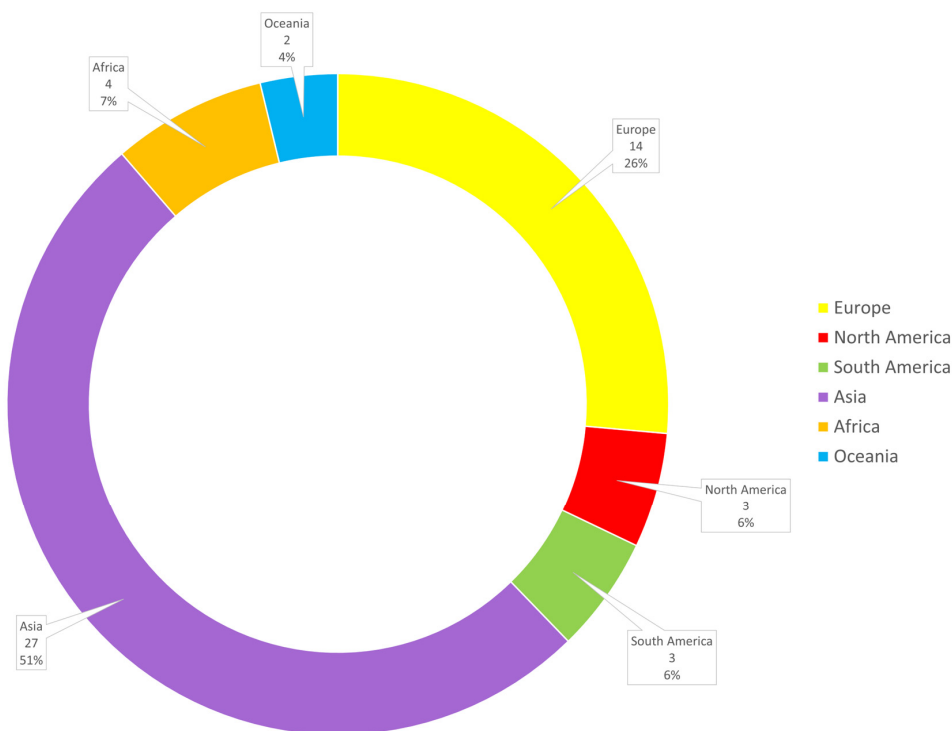


Figure 20. Number of Case Studies by Continent.

Going into greater detail and continuing the analysis at the individual country level (see Figure 21), it emerged that, for the Asian continent, most case studies are concentrated in Indonesia (8), India (4), and Malaysia (4). In Europe, Portugal, with three case studies, is joined by Italy, the UK, Poland, and Cyprus, each with two case studies. The same is noted for countries on other continents, such as the USA, Iran, Ecuador, Ethiopia, and Türkiye.

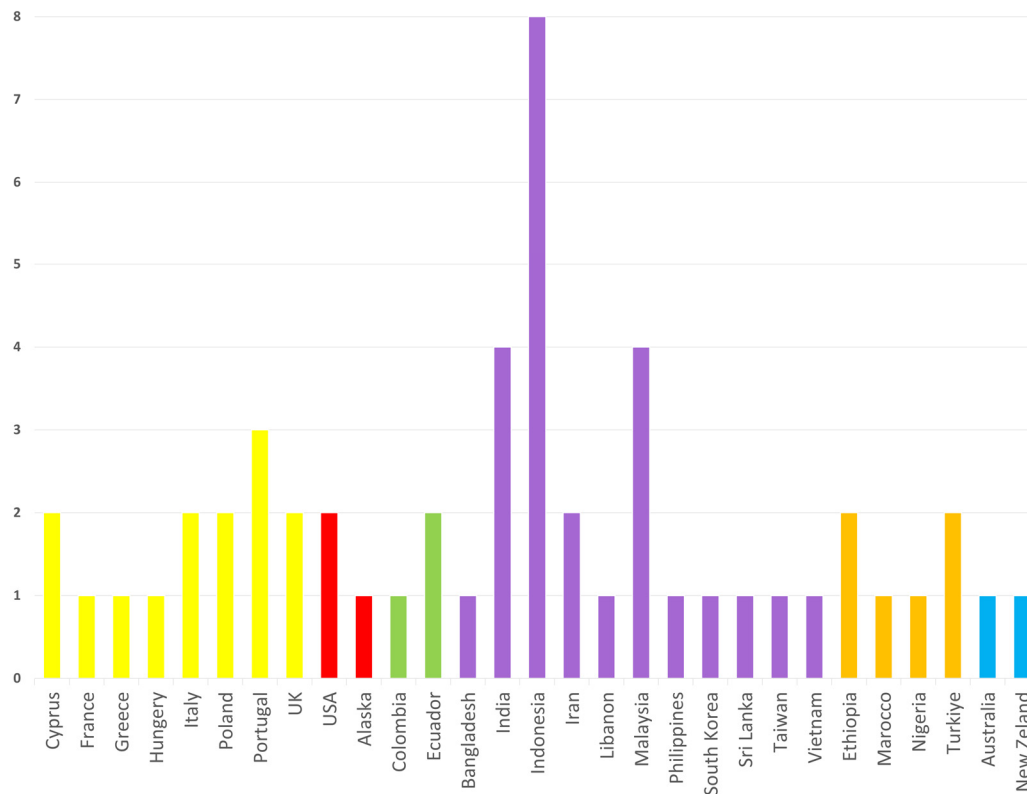


Figure 21. Number of Case Studies by Nation.

Once the countries where case studies were implemented had been determined, the next step was to verify the Main Technology (MT) used in those areas.

In this analysis, too, as shown in Figure 22, “Rainwater Harvesting System” (MT4) is used in the majority of the papers (87%). Although in a 1:10 ratio with the main one, the second-most-representative technology is the “Fog Harvesting System” (MT2—8%), while the remaining percentage points are divided among combinations of MT4 and the other MTs.

To highlight any differences between the complete set of 136 papers and the 53 characterised by the use of a case study, a comparative analysis was conducted according to the following categories:

- Main Technology (MT)
- Secondary Technology (ST)
- Integrated Technology (IT)
- Digital Tool (DT)

Based on this comparison, Table 7 provides a summary of the most common technologies. As already mentioned in the respective sections of this paper, the values in the MT category refer to 100% of the papers concerned, whereas the other three categories—ST, IT, and DT—do not reach 100% due to the multi-response nature of the data.

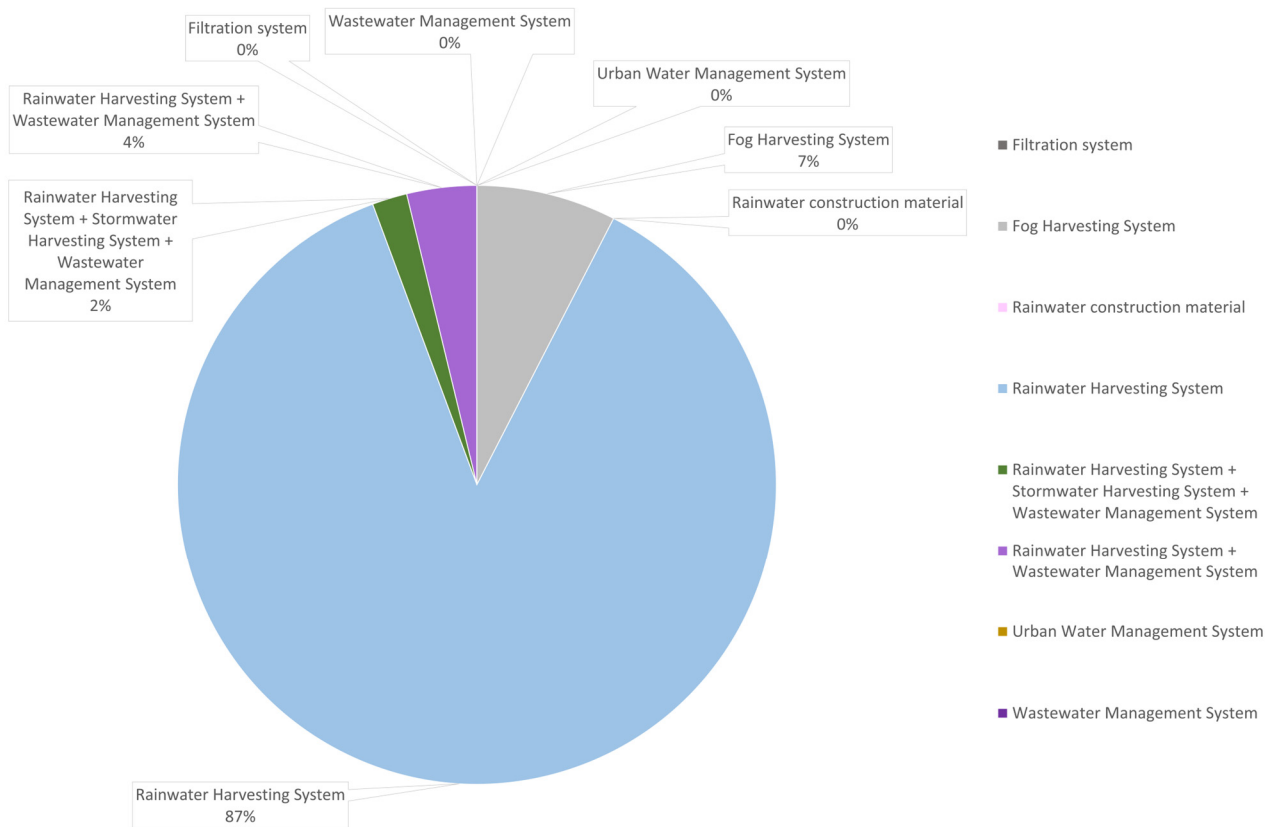


Figure 22. Analysis of the Main Technologies used in the case studies.

Table 7. Comparison between the complete set of 136 selected papers and the 53 characterised by Case Studies.

Cat.	136 Papers	Technology	53 Papers with Case Study
MT	113/136	Rainwater Harvesting System (MT4)	46/53
	9/136	Fog Harvesting System (MT2)	4/53
ST	38/68	Roof-based Collection System (ST1)	16/28
	32/68	Storage System (ST3)	14/28
IT	9/27	Water Reuse & Recycling System (IT1)	6/11
	5/27	Stormwater Management & Regulation System (IT2)	-
	4/27	Groundwater Interaction System (IT3)	3/11
	4/27	Green–Blue Infrastructure System (IT4)	-
DT	7/14	Decision Support & Performance Evaluation Tools (DT6)	2/7
	6/14	GIS & Geospatial Analysis Tools (DT1)	-
	-	BIM & Digital Building Modelling (DT2)	2/7

By considering only the papers featuring case studies that used MT4 and applying the same normalisation dictionaries previously used for Secondary Technology (ST), Integrated Technology (IT), and Digital Tool (DT), it was possible to analyse the relationship between the case studies and these technologies in greater depth (see Figure 23). Thanks to this analysis, we determined that, among the papers using MT4, 45% also feature an ST. In second place is the combined category of ST with IT, accounting for 7% of the papers concerned (Figure 24).

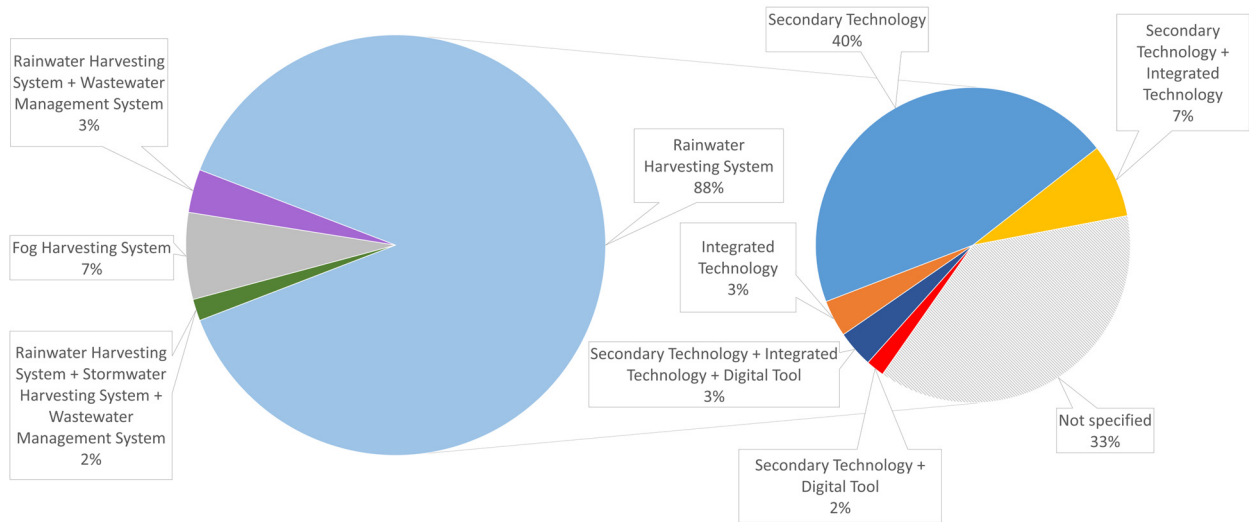


Figure 23. Breakdown of the Main Technology RWHS in relation to other Main Technologies.

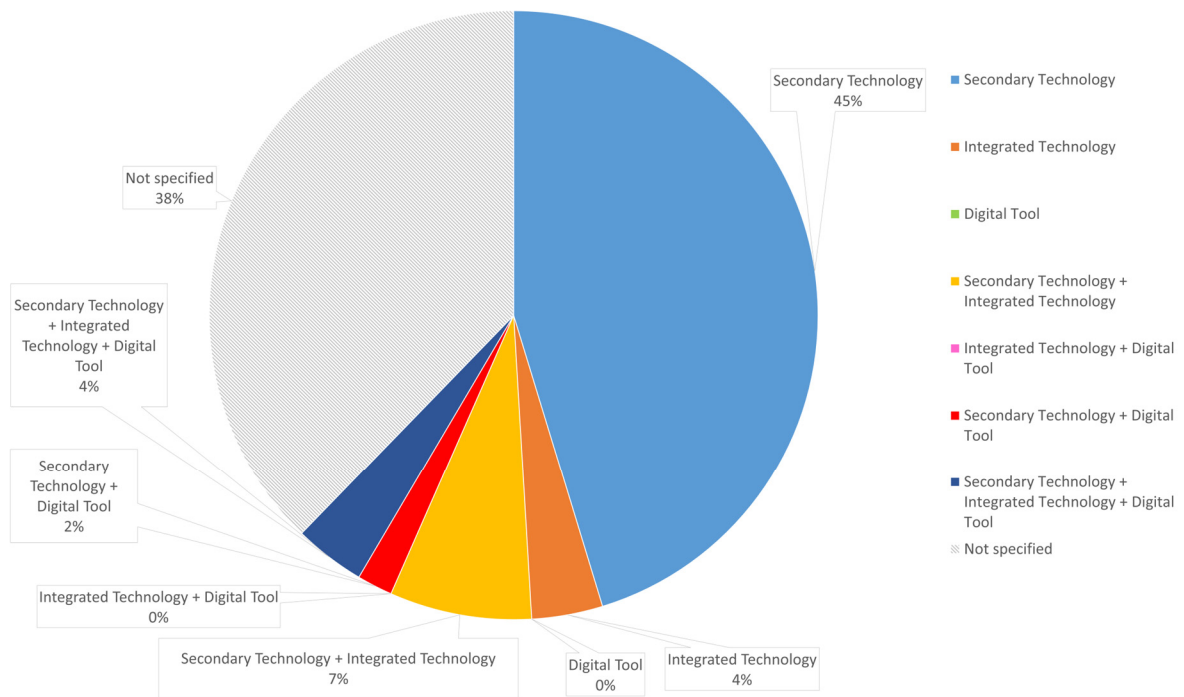


Figure 24. Breakdown of the Main Technology RWHS.

Specifically, the 46 papers that focus on the use of MT4 as the primary technology are accompanied only by an ST (the blue section in the pie chart in Figure 22).

Furthermore, going into greater detail and considering only the 46 papers characterised by the use of MT4—the light blue section of the primary pie chart in Figure 23—it was possible to analyse and catalogue the different relationships with ST, IT, and DT.

Specifically, the 28 papers in which the MT is accompanied by an ST were analysed using the same vocabulary used for the more general analysis in Figure 11. In this case, the analysis revealed and confirmed that ST1 (16) and ST3 (14) are the two most common STs (see Figure 25).

On the other hand, the 11 papers in which the MT is accompanied by an IT were analysed using the same vocabulary used for the more general analysis in Figure 12. This analysis revealed that IT1 is the most widely used IT category (6), followed by IT3 (3) (see Figure 26).

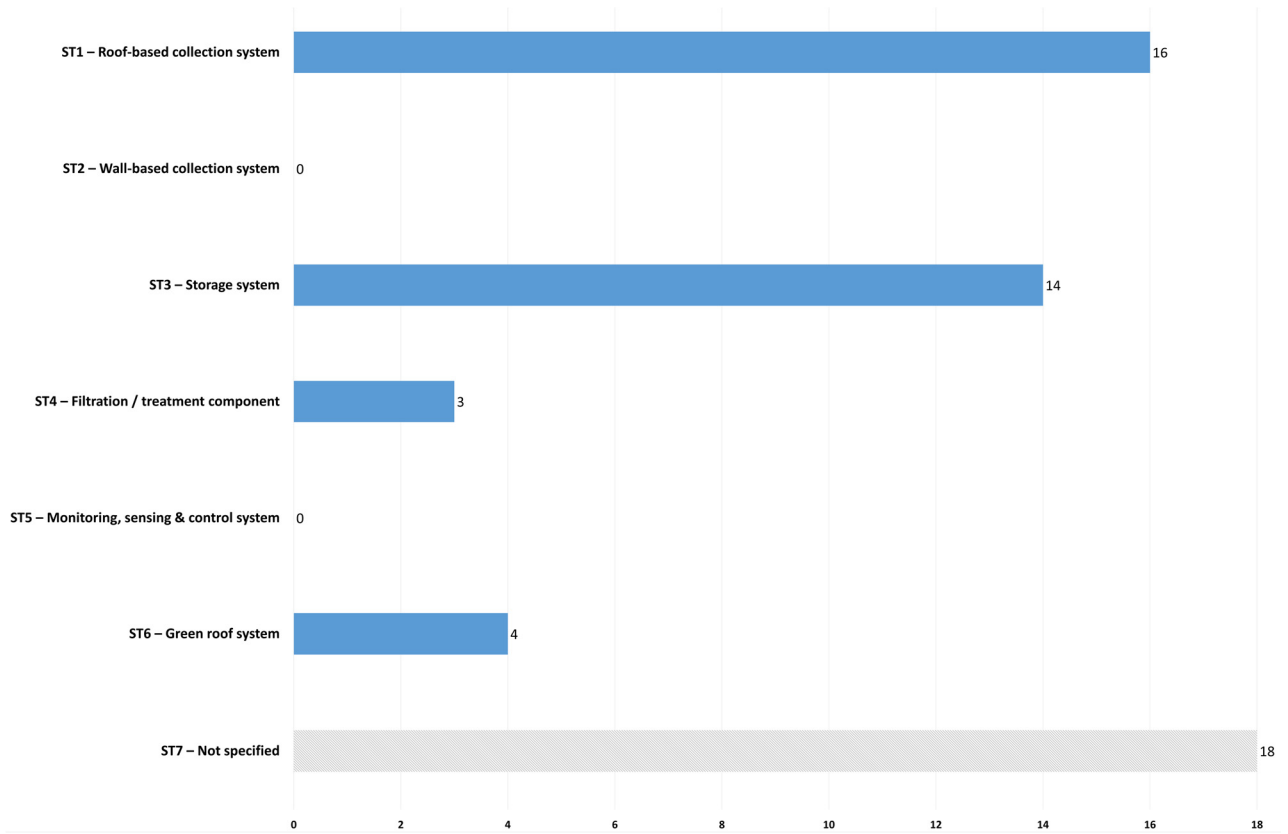


Figure 25. Case Studies characterised by Main Technologies with Secondary Technologies.

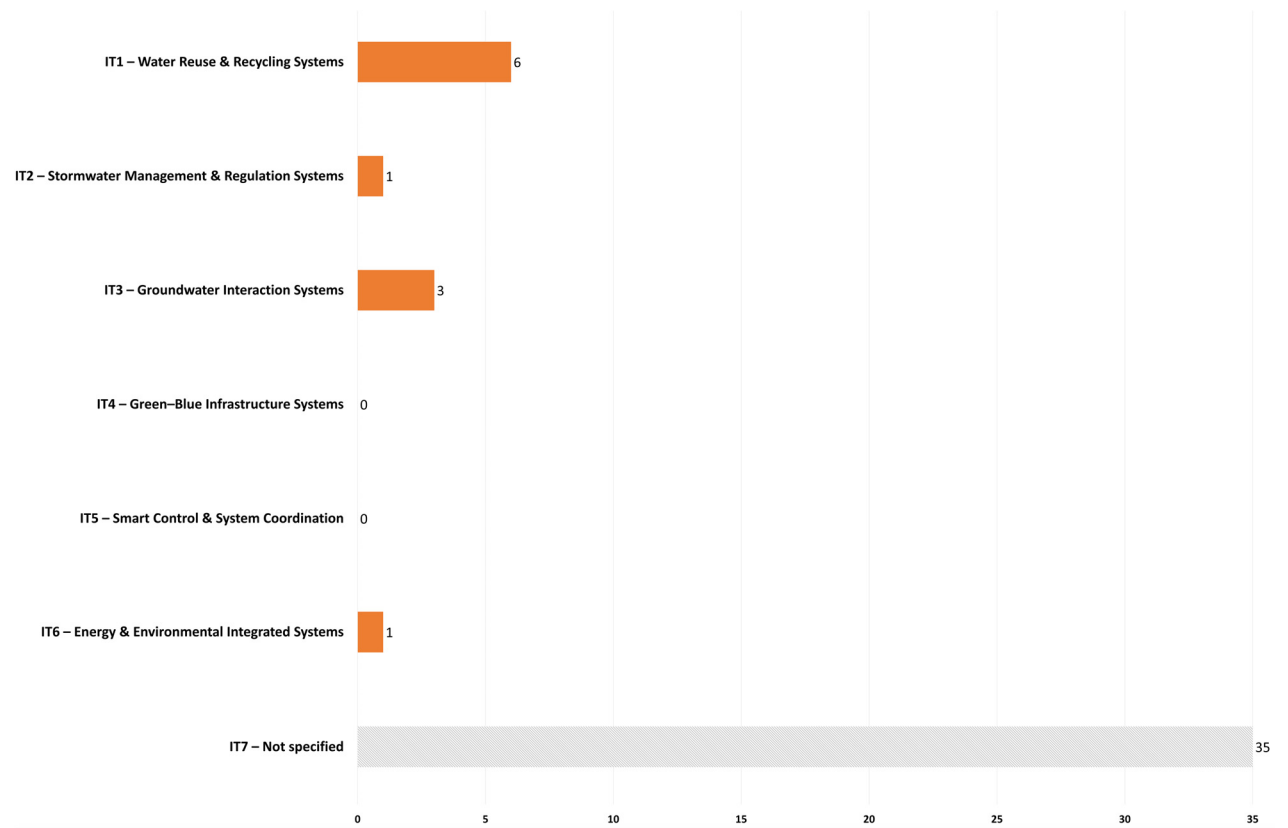


Figure 26. Case Studies characterised by Main Technologies with Integrated Technologies.

The seven papers in which the MT is accompanied by a DT, as in the previous two analyses, were analysed using the same vocabulary used for the more general analyses in Figure 13. In this case, the analysis revealed that DT6 and DT4 (2) are the most widely used DT categories (see Figure 27).

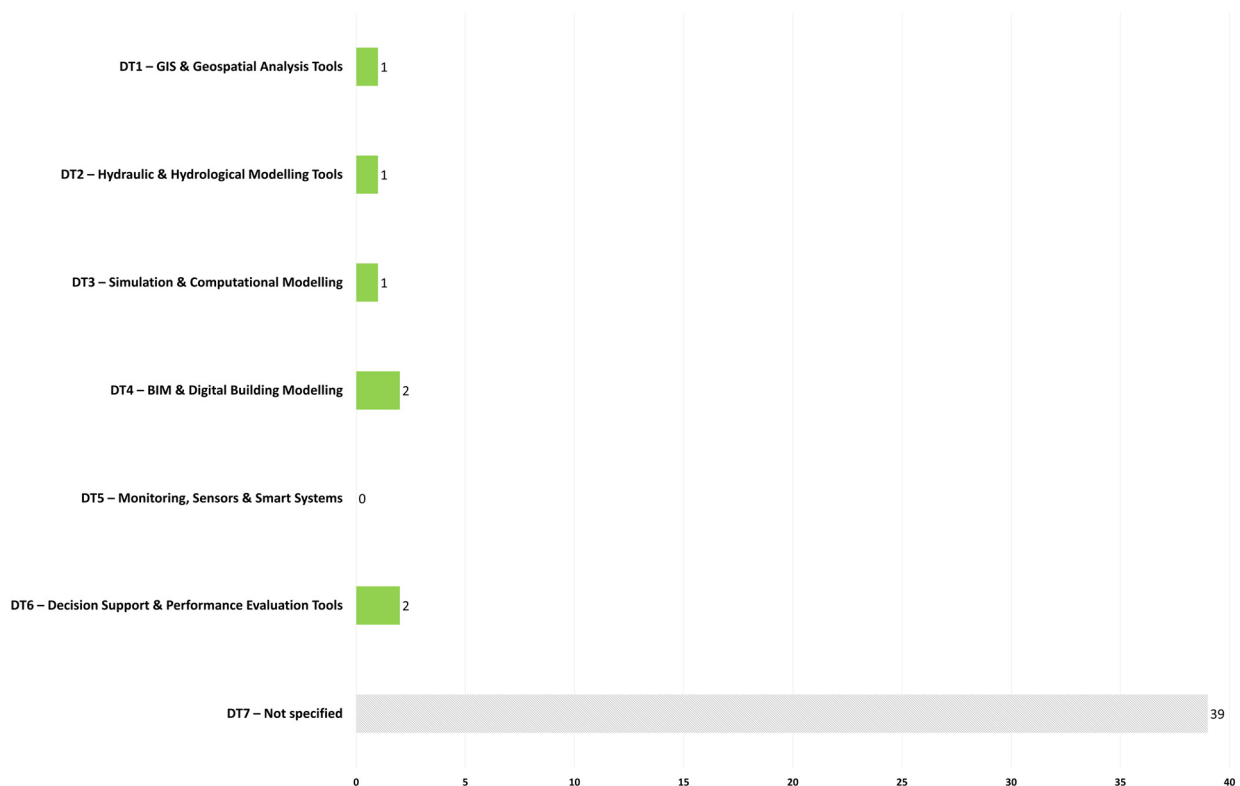


Figure 27. Case Studies characterised by Main Technologies with Digital Tools.

Again, the percentages indicate the proportion of articles in which each ST is present. The values do not add up to 100% because the data are multi-response.

6.2.5. Climate Analysis per Case Study Distribution

As shown by the analyses presented at the beginning of the previous paragraph (Section 6.2.4), the 53 case studies are distributed across 29 countries on all continents, excluding the poles.

Each continent and each country has its own distinctive climate, and studying these helps us better understand why certain locations were chosen for the case studies (see Figures 20 and 21).

The analysis is based on Köppen's climate classification [166], which assigns three letters to each area (the first refers to the Main Climate, the second to Precipitation, and the third to Temperature, as shown in Table 8).

The first step was to apply the above classification to the countries in the case studies, assigning a maximum value of 1 when a country had a single predominant climate, 0.5 when it had two main climates, and 0.3 when it had three main climates. This procedure was applied to highlight, for each country, both the generic climate (single-letter classification; see the Main climate column in Table 7) and the specific climate (classification based on the combination of the three letters in all three columns of Table 7). For these calculations, each climate was counted as many times as the number of occurrences of the country associated with it, to give the distribution of case studies greater weight. Once this analysis was complete, the values were converted to percentages to facilitate a comparison with global

climate percentages. Figure 28 shows the results of the climate distribution for the case studies, already expressed as percentages, for a comparison with the global distribution according to the Köppen–Geiger classification.

Table 8. Climate classification following the Köppen–Geiger Climate Zones [167].

	Main Climate	Precipitation	Temperature
A	Equatorial	W	Desert
B	Arid	S	Steppe
C	Warm Temperate	f	Fully Humid
D	Snow	s	Summer Dry
E	Polar	w	Winter Dry
		m	Monsoonal
			h
			Hot arid
			k
			Cold Arid
			h
			Hot Summer
			b
			Warm Summer
			c
			Cool Summer
			d
			Extremely Continental
			F
			Polar Frost
			T
			Polar Tundra

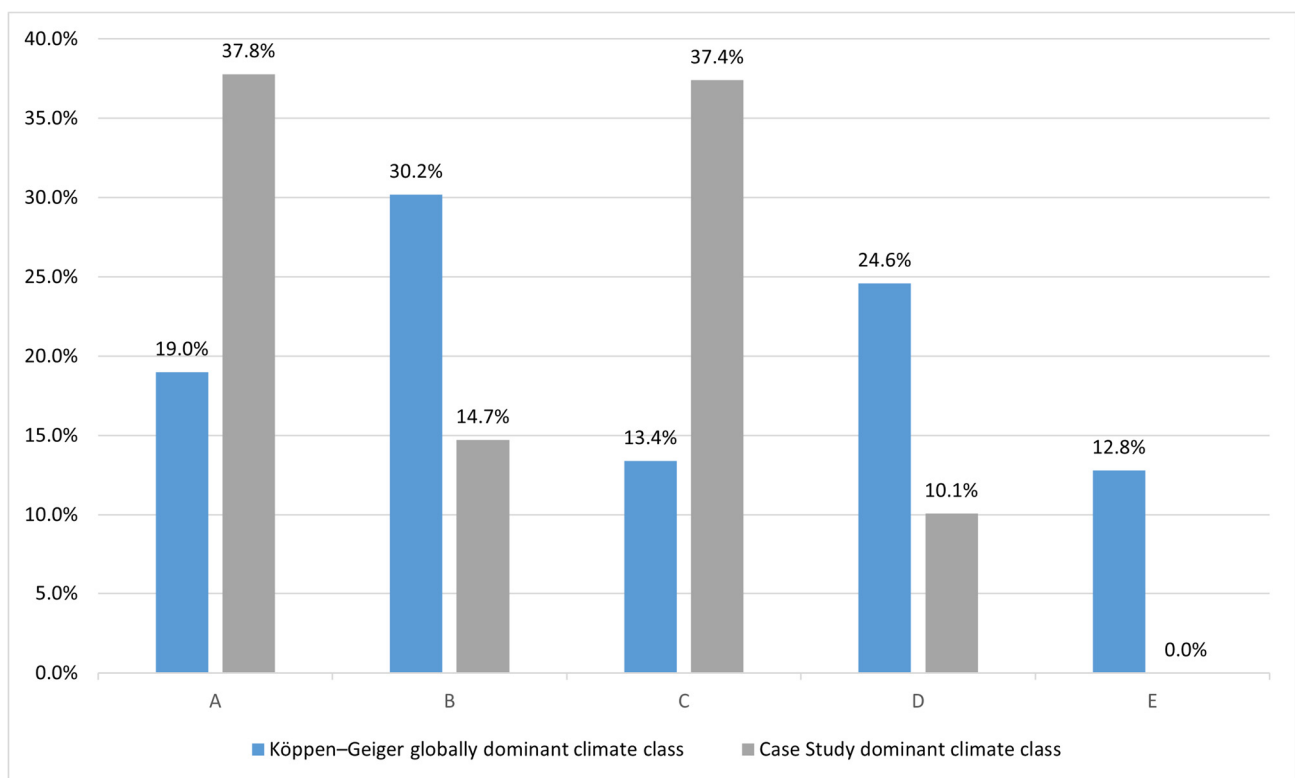


Figure 28. Comparison between Global and Case Study Köppen–Geiger Climate Class Distribution (A = Equatorial, B = Arid, C = Warm Temperate, D = Snow, E = Polar [168]).

This comparative graph, which aggregates the climates emerging from the papers characterised by case studies at a global level and weights them by frequency, shows that tropical (A) and temperate (C) climates account for 37.8% and 37.4% of the analysed dataset, respectively. Compared to the global distribution of Köppen–Geiger [168], these classes are significantly over-represented, while arid (B) and cold (D) climates are relatively under-represented. Polar climates (E), on the other hand, are completely absent from the case studies analysed.

This imbalance highlights how research on RWHS tends to focus on climatic contexts characterised by significant rainfall regimes or marked seasonal precipitation, i.e., where the availability of rainwater makes such solutions technically and economically more feasible.

On the other hand, it appears that arid and cold climates are less explored in the context of RWHS systems, even though they are characterised by specific water-related challenges.

7. Conclusions and Future Development

In conclusion, this scoping literature review shows that interest in research on RWHSs has increased since 2010, with a linear trend characterised by irregular peaks, mainly since 2020.

At a theoretical level, interest has grown steadily in Asia (41%) and Europe (37%), whereas in North America (11%), it began to emerge in 2015. At a practical level, however, case studies have been implemented mainly in Asia (51%) and Europe (26%). In fact, the clear prevalence of climate classes A and C, particularly those characterised by fully humid and monsoonal regimes, highlights that case studies of RWHS systems are mainly applied in contexts with high annual rainfall or marked seasonality, conditions that favour the effectiveness of collection and storage systems.

By referring to the Scale/Context of application (SC), these studies are generally conducted at the “Building Level” (SC1, 74%), with some interest also at the “Urban Level” (SA3, 7%). These data are also confirmed at the Building Element/Physical Location (BL), where “Roofs” (BL6, 26%) and “Tanks” (BL7, 14%) are the BLs most frequently mentioned.

When considering the Aim’s topic (AM), approximately 50% of the primary aims of the 136 selected papers are divided equally between “System Design, Integration, and Performance” (AM9), “Non-Potable Water Reuse” (AM6), and “Water Conservation and Efficiency” (AM10). Over 50% of the same set of papers have a secondary aim, of which 15% are equally represented by “Environmental and Resource Sustainability” (AM5) and “Alternative and Supplementary Water Supply” (AM1).

Even though the number of case studies on fog collection systems is significantly lower than that of rainwater harvesting systems (see Figure 22), the analysed papers report positive results for water collection in the specific climatic contexts considered. The results of this analysis contribute to advancing research in this field by providing not only a structured mapping of how different water harvesting technologies relate to specific climatic conditions and application contexts, but a functional interpretation of these technologies, clarifying their operational roles across building-scale water management systems, thereby supporting the development of more effective and context-adaptive design strategies for climate-resilient building systems.

Based on the results of this scoping review, the next step in future developments will be to focus on and investigate the integrated application of the two most representative technologies (see Figures 9 and 23). This involves the use of Rainwater Harvesting Systems (RWHS) on roofs, combined with Fog Collectors on façades.

This technological integration aims to enhance overall water collection performance by combining mechanisms for collecting precipitation and atmospheric humidity. This strategy aims to increase the amount of water harvested, particularly in climates characterised by seasonal variability.

To continue this study, during the final drafting phase of this article, work began on defining a scalable prototype adaptable to different climatic and urban contexts.

In addition to further investigating rainwater and wastewater management systems, future research will focus on testing and validating this integrated configuration through selected case studies across different geographical and climatic areas.

8. Limitations

In this scoping review, to ensure the accessibility and transparency of the methodological approach, only articles indexed in the Scopus database and published in Open Access journals were considered. However, this decision imposes a limitation that may introduce

selection bias, potentially excluding high-quality studies available in other bibliographic databases (e.g., Web of Science, ProQuest) or in non-Open Access journals.

The selected time period (2010–2024), chosen to capture technological developments and innovations in the field of RWH, may have overlooked relevant earlier contributions.

Furthermore, in line with the nature and objectives of scoping reviews, no formal critical appraisal of the included articles was conducted, as this is not mandatory in this type of review.

Although the decision to include only English-language publications may have excluded relevant studies published in other languages, it was adopted to ensure international comparability.

A preliminary quantitative support procedure based on cosine similarity was considered to facilitate the management of the dataset. However, the final selection of 136 articles was made through a comprehensive manual screening of all 343 records.

No review protocol was registered prior to conducting this study. However, the review process was conducted in accordance with the PRISMA-ScR guidelines to ensure methodological transparency and reproducibility.

Despite these limitations, the structured methodological approach adopted and the broad scope of the literature considered ensure that the review provides a comprehensive and representative overview of the technologies used in RWHSs.

Author Contributions: Conceptualisation, U.M.C. and D.P.; methodology, U.M.C.; software, U.M.C.; validation, G.W. and G.R.; formal analysis, U.M.C.; investigation, U.M.C.; resources, U.M.C., D.P., and G.W.; data curation, U.M.C.; writing—original draft preparation, U.M.C.; writing—review and editing, U.M.C. and D.P.; visualisation, U.M.C. and D.P.; supervision, G.W. and G.R.; project administration, D.P., G.W., and G.R.; All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

BC	Before Christ
UN	United Nations
SDG	Sustainable Development Goal
AECO	Architecture, Engineering, Construction and Operations
AI	Artificial Intelligence
MT	Main Technology
MT1	Filtration System
MT2	Fog Harvesting System
MT3	Rainwater Construction Material
MT4	Rainwater Harvesting System
MT5	Stormwater Harvesting System
MT6	Urban Water Management System

MT7	Wastewater Management System
ST	Secondary Technology
IT	Integrated Technology
DT	Digital Tool
ST1	Roof-based collection system
ST2	Wall-based collection system
ST3	Storage system
ST4	Filtration/treatment component
ST5	Monitoring, sensing and control system
ST6	Green roof system
ST7	Not specified
IT1	Water Reuse and Recycling Systems
IT2	Stormwater Management and Regulation Systems
IT3	Groundwater Interaction Systems
IT4	Green–Blue Infrastructure Systems
IT5	Smart Control and System Coordination
IT6	Energy and Environmental Integrated Systems
IT7	Not specified
DT1	GIS and Geospatial Analysis Tools
DT2	Hydraulic and Hydrological Modelling Tools
DT3	Simulation and Computational Modelling
DT4	BIM and Digital Building Modelling
DT5	Monitoring, Sensors and Smart Systems
DT6	Decision Support and Performance Evaluation Tools
DT7	Not specified
SC	Scale/Context
SC1	Building-scale
SC2	Site-scale
SC3	Urban-scale
SC4	Regional-scale
SC5	Subsurface
SC6	Not specified
BL	Building Element/Physical Location
BL1	Ground
BL2	Pipe
BL3	Internal hydraulic surface
BL4	Pavement
BL5	Green roof
BL6	Roof
BL7	Tank
BL8	Façade
BL9	Living façade
BL10	Wall
BL11	Urban green infrastructure
BL12	Not specified
BA	Building Area
BA1	Ground Area
BA2	Wall Area
BA3	Roof Area
BA4	Internal hydraulic Area
BA5	Element
BA6	Not specified
AM	Aim
AM1	Alternative and Supplementary Water Supply

AM2	Climate Change Adaptation and Resilience
AM3	Decentralised, Urban and Social Water Systems
AM4	Energy and Economic Performance
AM5	Environmental and Resource Sustainability
AM6	Non-Potable Water Reuse
AM7	Potable Water Quality and Treatment
AM8	Stormwater and Flood Management
AM9	System Design, Integration and Performance
AM10	Water Conservation and Efficiency
AM11	Not Specified
UK	United Kingdom
USA	United States of America
RWHS	Rainwater Harvesting System
RWH	Rainwater Harvesting
FC	Fog Collector
FH	Fog Harvesting

Appendix A

Table A1. List of the 136 selected papers [6,16,23,33–165].

Num	Authors	Title	Year
001	Wartalska K., Grzegorzek M., Bełcik M., Wdowikowski M., Kolanek A., Niemierka E., Jadwiszczak P., Kaźmierczak B.	The Potential of Rainwater Harvesting Systems in Europe—Current State of Art and Future Perspectives	2024
002	Zhang J., Asutosh A.T., Zhang Y.	Sustainability Research of Building Systems Based on Neural Network Predictive Models and Life Cycle Assessment (LCA)—Emergy—Carbon Footprint Method	2024
003	Matos C., Bentes I., Santos C.	Rainwater Harvesting System for Industrial Buildings: The Case Study Of Continental Advanced Antenna, Vila Real, Portugal	2024
004	Borgert A.E., Ghisi E.	The Impact of the Water Tariff on the Economic Feasibility of Rainwater Harvesting for Use in Residential Buildings	2024
005	Stec A., Słyś D., Ogarek P., Bednarz K., Bartkowska I., Gwoździej-Mazur J., Iwanek M., Kowalska B.	Assessment of Possibilities of Using Local Renewable Resources in Road Infrastructure Facilities—A Case Study from Poland	2024
006	Bouzina A.M., Belmeziti A., de Gouvello B.	How to Improve Inhabitants' Acceptance of Rainwater Harvesting Systems? Application to an Existing Collective Residence in Northern Algeria	2024
007	Musz-Pomorska A., Widomski M.K., Gołębiowska J.	Financial Aspects of Sustainable Rainwater Management in Small-Scale Urban Housing Communities	2024
008	Opher T., Friedler E.	Sustainability Assessment of Harvesting Rainwater and Air-Conditioning Condensate Water in Multi-Family Residential Buildings under Various Conditions in Israel—A Simulation Study	2024
009	Diana L., Passarelli C., Polverino F., Pugliese F.	A Decision Framework for the Regeneration Awareness of Large-Sized Public Housing Using a Building Transformability Assessment: A Test Case In Italy (Latina)	2024
010	Chen X., Zhang Z., Abed A.M., Lin L., Zhang H., Escorcia-Gutierrez J., Shohan A.A.A., Ali E., Xu H., Assilzadeh H., Zhen L.	Designing Energy-Efficient Buildings in Urban Centers through Machine Learning and Enhanced Clean Water Managements	2024

Table A1. Cont.

Num	Authors	Title	Year
011	Carrera-Villacrés D.V., Gallegos Rios D.F., Chilingua López Y.A., Córdova Córdova J.J., Arroba Giraldo A.M.	The Implementation of IoT Sensors in Fog Collector Towers and Flowmeters for the Control of Water Collection and Distribution	2024
012	Antão-Geraldes A.M., Ohara G., Afonso M.J., Albuquerque A., Silva F.	Towards Sustainable Water Use in Two University Student Residences: A Case Study	2024
013	Meskele D.Y., Shomre M.W., Soche T.K.	Evaluating Rooftop Rainwater Harvesting Potential to Satisfy Urban Water Demand in Hosaena City, South Central Ethiopia	2024
014	Ranasingha C.M., Wattage P.	Rainwater Harvesting (RWH) Systems: Is the Conservation of Water in Colombo Urban Areas Worth It?	2024
015	Mir A.B., Bahadur F.T., Khaja M.A., Ghani W., Choudhary Z., Kumar S., Beigh F.A., Bahadur F.F., Taley W.R., Ahmad D.	A Sustainable Design Approach of a Mega Hostel: A Study Based at NIT, Srinagar, Kashmir, India	2024
016	Hamdi T., Atabay Ş.	Should We Value Rain Harvesting More in Türkiye for Mitigating Precipitation Extremes	2024
017	Sun M., Zhang J., Wang Z., Ran J., Han Y., Zhang J., Li H., Zhang L.	Effect of Water Tank Size and Supply on Greenhouse-Grown Kidney Beans Irrigated by Rainwater in Cold and Arid Regions of North China	2024
018	Tholibon D.A., Mokhtar H., Latib F.W.M., Ismail M.I., Nujid M.M., Salam R.	The Capability of Rainwater Harvesting as an Alternative Water Supply	2024
019	Syahputra B.	Utilization of Rainwater Harvesting to Conserve Water in Buildings in Semarang City	2024
020	Liu Z., Li S., Wu H., Yang K.	Engineering and Technical Research on Combined Application of Stormwater Regulation Pond and PP Modular Cistern in Wet Trapped Loess Area	2024
021	Pranoto W.A., Jin O.F., Dharmawan I., Gunawan F.	Analysis of Rainwater Utilization for Landscaping and Sanitation Needs at Kalvari Church, Jakarta	2024
022	Burszta-Adamiak E., Przybylska A.	The Potential for Sustainable Rainwater Management through Domestic Rainwater Harvesting Based on Real Rainfall	2024
023	Pimentel-Rodrigues C., Silva-Afonso A.	The Feasibility of Rainwater Harvesting Systems in Buildings with Green Roofs: A Case Study Based on the Köppen Climate Classification	2023
024	Rosli M.I., Abdullah S., Noor N.A.M.	Utilizing Rainwater Harvesting System for Water Scarcity at a Double-Story Residential House	2023
025	Dudkiewicz E., Ludwińska A.	Family Dwelling House Localization in Poland as a Factor Influencing the Economic Effect of Rainwater Harvesting System with Underground Tank	2023
026	Mogano M.M., Okedi J.	Assessing the Benefits of Real-Time Control to Enhance Rainwater Harvesting at a Building in Cape Town, South Africa	2023
027	Gembarski P.C., Melching J., Plappert S.	A Knowledge-Based Engineering System for the Planning of Networked Rainwater Harvesting and Distribution Systems	2023
028	Sahraoui M., Chergui S., Belmeziti A., Zegait R.	Ingenious Rainwater Harvesting System within the Algiers Ottoman Residential Buildings (Reconstitution and Performance Assessment)	2023
029	Patel M., Pant V., Sikligar H., Quadri S., Bachar N., Maurya N.	Harnessing Conventional Wisdom for Rain Water Harvesting to Mitigate the Risks of Climate Change	2023
030	Himat A., Dogan S.	The Impact of the Regularization on the Economic Analysis of Rooftop Rainwater Harvesting System	2023

Table A1. Cont.

Num	Authors	Title	Year
031	Schild J.E.M., Fleskens L., Riksen M., Shadeed S.	Economic Feasibility of Rainwater Harvesting Applications in the West Bank, Palestine	2023
032	Hernandez Rosales B., Lutz A.	Assessing the Feasibility of Rooftop Rainwater Harvesting for Food Production in Northwestern Arizona on the Hualapai Indian Reservation	2023
033	Kilinc E.A., Tanik A., Hanedar A., Gorgun E.	Climate Change Adaptation Exertions on the Use of Alternative Water Resources in Antalya, Türkiye	2023
034	Syahputra B., Kiono B.F.T., Sudarno	Water Conservation Model in Hotel and Apartment Building in Semarang City, Indonesia	2023
035	Pool T., Williams M., McDonald C., Loderhose P., Velasco J., Lefthand-Begay C.	Advancing Water Justice through a Tribally-Driven Partnership: Designing Sustainable Rainwater Harvesting Systems in the Yukon–Kuskokwim Delta of Alaska	2023
036	Oraya A.F.A., Cuba G.J.G., Varquez L.L.M., Hermosa J.C.R.	Rainwater Harvesting Tank Sizing: A Case in Urban Catchments in Metro Cebu	2023
037	Cristiano E., Farris S., Deidda R., Viola F.	How Much Green Roofs and Rainwater Harvesting Systems Can Contribute to Urban Flood Mitigation?	2023
038	Rhamadita T.S., Setyandito O., Novandy, Anda M.	Study of Rainwater Harvesting as a Water Conservation in Mall Building in South Tangerang	2023
039	Zhou W., Matsumoto K., Sawaki M.	Understanding the Traditional Wisdom of Harvesting Rainwater in Household Yards: Construction and Rainwater Usage Patterns of Settlement Water Cellars in Semi-Arid China	2023
040	Aulia A.N., Dewi O.C.	Wastewater Management Optimization in the Integrated Teaching Laboratory Building	2022
041	Khan A., Park Y., Park J., Kim R.	Assessment of Rainwater Harvesting Facilities Tank Size Based on a Daily Water Balance Model: The Case of Korea	2022
042	Carollo M., Butera I., Revelli R.	Water Savings and Urban Storm Water Management: Evaluation of the Potentiality of Rainwater Harvesting Systems from the Building to the City Scale	2022
043	Asif M., Yadav R., Sugha A., Bhatti M.S.	Chemical Composition and Source Apportionment of Winter Fog in Amritsar: An Urban City of North-Western India	2022
044	Garrido-Baserba M., Barnosell I., Molinos-Senante M., Sedlak D.L., Rabaey K., Schraa O., Verdaguer M., Rosso D., Poch M.	The Third Route: A Techno-Economic Evaluation of Extreme Water and Wastewater Decentralization	2022
045	Gómez-Monsalve M., Domínguez I.C., Yan X., Ward S., Oviedo-Ocaña E.R.	Environmental Performance of a Hybrid Rainwater Harvesting and Greywater Reuse System: A Case Study on a High Water Consumption Household in Colombia	2022
046	Hasan M.A., Irfanullah H.M.	Exploring the Potential for Rainwater Use for the Urban Poor in Bangladesh	2022
047	Van de Walle A., Torfs E., Gaublomme D., Rabaey K.	In Silico Assessment of Household Level Closed Water Cycles: Towards Extreme Decentralization	2022
048	Wang Y.H., Ger T.H., Lou J.R., Chang Chien C.T.	Water-saving Strategies in the Face of Water Shortage Crisis: A Case Study of Science Museum in Taiwan	2022
049	Firdausa R.R., Ardiani Y.M.	Water Conservation Calculations in Eco-Friendly Office in South Jakarta	2022
050	Pimentel-Rodrigues C., Silva-Afonso A.	Rainwater Harvesting for Irrigation of Tennis Courts: A Case Study	2022
051	Al-Houri Z., Al-Omari A.	Assessment of Rooftop Rainwater Harvesting in Ajloun, Jordan	2022

Table A1. Cont.

Num	Authors	Title	Year
052	Ulker E., Tasci H.	Determining Rainwater Harvesting Potentials in Municipalities by a Semi-Analytical Method	2022
053	Stec A., Słyś D.	Financial and Social Factors Influencing the Use of Unconventional Water Systems in Single-Family Houses in Eight European Countries	2022
054	Yoo C., Cho E., Lee M., Kim S.	Observation Experiment of Wind-Driven Rain Harvesting from a Building Wall	2022
055	Xu W.D., Burns M.J., Cherqui F., Smith-Miles K., Fletcher T.D.	Coordinated Control Can Deliver Synergies Across Multiple Rainwater Storages	2022
056	Zang J., Royapoor M., Acharya K., Jonczyk J., Werner D.	Performance Gaps of Sustainability Features in Green Award-Winning University Buildings	2022
057	Praveena S.M., Themudu S.	Water Conservation Initiative in a Public School from Tropical Country: Performance and Sustainability Assessments	2022
058	da Silva M.B.M., Brandão I.A.P., Ribeiro M.M.R.	Feasibility, Seasonality and Reliability of Rainwater Harvesting in Buildings of a University in Campina Grande, Paraíba	2022
059	Stangl R., Minixhofer P., Wultsch T., Briefer A., Scharf B.	Green-Blue Infrastructure in the Built Environment—Sustainable and Resource-Saving Designs for Urban Structures and Open Spaces	2022
060	Begum M.S., Bala S.K., Saiful Islam A.K.M.	Effect of Performance of Water Stashes Irrigation Approaches on Selected Species of Plant's Water Productivity in Urban Rooftop Agriculture with Respect to Climate Change	2022
061	Shiguang C., Hongwei S., Qiuli C.	Performance of an Innovative Gravity-Driven Micro-Filtration Technology for Roof Rainwater Treatment	2021
062	Snir O., Friedler E.	Dual Benefit of Rainwater Harvesting—High Temporal-Resolution Stochastic Modelling	2021
063	Csete A.K., Kolcsar R.A., Gulyas A.	Rainwater Harvesting Potential and Vegetation Irrigation Assessment Derived from Building Data-Based Hydrological Modeling through the Case Study of Szeged, Hungary	2021
064	Herdiansyah H.	Climate Village Program for Climate Change Adaptation and Mitigation for Green Villages	2021
065	Abellán García A.I., Cruz Pérez N., Santamarta J.C.	Sustainable Urban Drainage Systems in Spain: Analysis of the Research on SUDS Based on Climatology	2021
066	Yew M.C., Wong S.W., Yew M.K., Saw L.H.	Rainwater Harvesting System Integrated With Sensors for Attic Temperature Reduction	2021
067	Ariyani D., Wulandari A., Juniati A., Nur Arini R.	Rainwater Harvesting for Water Security in Campus (case study Engineering Faculty in University of Pancasila)	2021
068	Sharifvaghefi S., Kazerooni H.	Fog Harvesting: Combination and Comparison of Different Methods to Maximize the Collection Efficiency	2021
069	Arden S., Morelli B., Cashman S., Ma X.C., Jahne M., Garland J.	Onsite Non-potable Reuse for Large Buildings: Environmental and Economic Suitability as a Function of Building Characteristics and Location	2021
070	Burszta-Adamiak E., Spsychalski P.	Water Savings and Reduction of Costs through the Use of a Dual Water Supply System in a Sports Facility	2021
071	Pirouz B., Palermo S.A., Turco M.	Improving the Efficiency of Green Roofs Using Atmospheric Water Harvesting Systems (An Innovative Design)	2021
072	Shiguang C., Yu Z.	Water Saving Potential and Economic Viability Assessment of Rainwater Harvesting System for Four Different Climatic Regions in China	2021

Table A1. Cont.

Num	Authors	Title	Year
073	Sharma S., Mukherjee M., Khare D.	Sustainable Strategies for Water Management Challenges in Hill-Towns	2021
074	Andres J.F., Loretero M.E.	Energy Equivalent of Rainwater Harvesting for High-Rise Building in the Philippines	2021
075	Silvia C.S., Ikhsan M., Safriani M., Gusmilia T.P.	Efficiency Rainwater Harvesting at the Roof Campus Buildings	2021
076	Mostaffa M.F., Musa S.M.S., Zainal R., Kasim N., Noh H.M., Yassin A.M.	E-SPAH: Aesthetic Innovation in UTHM's Small-Scale Rainwater Harvesting System	2021
077	Lestari E., Mekar Ageng Kinasti R.R., Putri D.	Utilization of Rainwater Harvesting for Groundwater Conservation in Educational Building	2020
078	Pirouz B., Turco M., Palermo S.A.	A Novel Idea for Improving the Efficiency of Green Walls in Urban Environment (An Innovative Design and Technique)	2020
079	Ledesma G., Nikolic J., Pons-Valladares O.	Bottom-Up Model for the Sustainability Assessment of Rooftop-Farming Technologies Potential in Schools in Quito, Ecuador	2020
080	van Dijk S., Lounsbury A.W., Hoekstra A.Y., Wang R.	Strategic Design and Finance of Rainwater Harvesting to Cost-Effectively Meet Large-Scale Urban Water Infrastructure Needs	2020
081	Antunes L.N., Sydney C., Ghisi E., Phoenix V.R., Thives L.P., White C., Garcia E.S.H.	Reduction o Environmental Impacts Due to Using Permeable Pavements to Harvest Stormwater	2020
082	Yu J., Wang J.	Optimization Design of a Rain-Power Utilization System Based on a Siphon and Its Application in a High-Rise Building	2020
083	Raya R.K., Gupta R.	Rural Community Water Management through Directional Tunnelling: Visual Modelling of Rainwater Harvesting System	2020
084	Villar-Navascués R., Pérez-Morales A., Gil-Guirado S.	Assessment of Rainwater Harvesting Potential from Roof Catchments through Clustering Analysis	2020
085	Lestari E., Pranoto W.A., Makarim C.A.	Utilization of Rainwater Harvesting Installation to Fulfil Water Needs in Educational Buildings	2020
086	Karimidastenaei Z., Torabi Haghighi A., Rahmati O., Rasouli K., Rozbeh S., Pirnia A., Pradhan B., Kløve B.	Fog-Water Harvesting Capability Index (FCI) Mapping for a Semi-Humid Catchment Based on Socio-Environmental Variables and Using Artificial Intelligence Algorithms	2020
087	Corvaro S.	Water Efficiency and Economic Assessment of Domestic Rainwater Harvesting Systems in Buildings with One- to Three-Floor Elevations	2019
088	Ruso M., Akintuğ B., Kentel E.	Optimum Tank Size for a Rainwater Harvesting System: Case Study for Northern Cyprus	2019
089	Molaei O., Kouchakzadeh M., Fashi F.H.	Evaluation of Rainwater Harvesting Performance for Water Supply in Cities with Cold and Semi-Arid Climate	2019
090	Sambas N.F.B., Baloo L., Mustaffa A.P.Z.	Rainwater Harvesting with Subsequent First Flush: Water Quality Performance for Non-Potable Purpose	2019
091	Stec A., Zelenáková M.	An Analysis of the Effectiveness of Two Rainwater Harvesting Systems Located in Central Eastern Europe	2019
092	Bint L., Garnett A., Siggins A., Jaques R.	Alternative Water Sources in New Zealand's Commercial Buildings	2019
093	Pimentel-Rodrigues C., Siva-Afonso A.	Reuse of Resources in the Use Phase of Buildings. Solutions for Water	2019
094	Prokić M., Savić S., Pavić D.	Pluvial Flooding in Urban Areas Across the European Continent	2019

Table A1. Cont.

Num	Authors	Title	Year
095	Toboso-Chavero S., Nadal A., Petit-Boix A., Pons O., Villalba G., Gabarrell X., Josa A., Rieradevall J.	Towards Productive Cities: Environmental Assessment of the Food-Energy-Water Nexus of the Urban Roof Mosaic	2019
096	Prayogo T.B., Susilo G.E.	Rainwater Harvesting and Electricity Saving on Household Scale	2019
097	Madzia M.	Reduction of Treated Water Use through Application of Rainwater Tanks in Households	2019
098	Karima A., Shafiul Islam K.M.	Drinking Water Desalination Using Low-Cost Tubular Solar Still	2019
099	Pharmawati K., Hidayatullah D., Wirasakti P.	Identification the Application of Water Conservation in Hotel	2018
100	Caldas L., Andaloro A., Calafiore G., Munechika K., Cabrini S.	Water Harvesting from Fog Using Building Envelopes: Part I	2018
101	Radzali N.A.W.M., Shafri H.Z.M., Norman M., Saufi S.	Roofing Assessment for Rooftop Rainwater Harvesting Adoption Using Remote Sensing and GIS Approach	2018
102	Devitama F.F., Paramita B.	Sustainable Development Concept of Rain Harvesting for Public Flat in Tamansari Village, Bandung	2018
103	Caldas L., Andaloro A., Calafiore G., Munechika K., Taube B., Oliveira M., Cabrini S.	Water Harvesting from Fog Using Building Envelopes: Part II	2018
104	Farnum R.L.	Drops of Diplomacy: Questioning the Scale of Hydro-Diplomacy through Fog-Harvesting	2018
105	Sari S.P., Suhendri	Potential of Rainwater System for Domestic Building in Jakarta	2018
106	Sion Ong Y., Sim Ong K., Tan Y.K., Ghadimi A.	The Enhancement of Pre-Storage Filtration Efficiency for the Rainwater Harvesting System in Malaysia	2018
107	Yan X., Ward S., Butler D., Daly B.	Performance Assessment and Life Cycle Analysis of Potable Water Production from Harvested Rainwater by a Decentralized System	2018
108	Firmansyah, Kusuma B.N., Prayuni I., Fernando A.	Principles and Concepts in Designing Tropical-Shore Settlement in Estuary Ecosystem, Case Study: Weriagar District, Bintuni Bay	2018
109	Najifar P., Kurtay C.	Harvesting Feasibility of Rain Water in Buildings	2018
110	Nnaji C.C., Edeh G.C., Nnam J.P., Jr.	Status of Domestic Water Supply and Prospects of Rainwater Harvesting in Southeastern Nigeria	2018
111	Bowley W., Mukhopadhyaya P.	A Sustainable Design for an Off-Grid Passive Container House	2017
112	Ghimire S.R., Johnston J.M., Ingwersen W.W., Sojka S.	Life Cycle Assessment of a Commercial Rainwater Harvesting System Compared with a Municipal Water Supply System	2017
113	Traboulsi H., Traboulsi M.	Rooftop Level Rainwater Harvesting System	2017
114	Komeh Z., Memarian H., Tajbakhsh S.M.	Reservoir Volume Optimization and Performance Evaluation of Rooftop Catchment Systems in Arid Regions: A Case Study of Birjand, Iran	2017
115	Angrill S., Segura-Castillo L., Petit-Boix A., Rieradevall J., Gabarrell X., Josa A.	Environmental Performance of Rainwater Harvesting Strategies in Mediterranean Buildings	2017
116	Foo S.W., Mah D.Y.S., Ayu B.E.	Modelling Rainwater Harvesting for Commercial Buildings	2017
117	Valdez M.C., Adler I., Barrett M., Ochoa R., Pérez A.	The Water-Energy-Carbon Nexus: Optimising Rainwater Harvesting in Mexico City	2016
118	Silveira A., Abrantes J.R.C.B., De Lima J.L.M.P., Lira L.C.	Modelling Runoff on Ceramic Tile Roofs Using the Kinematic Wave Equations	2016

Table A1. Cont.

Num	Authors	Title	Year
119	Dodo Y.A., Lei L.X., Hussein A.	Annexing Green Building Rating Points through Multipurpose Vertical Light Pipes	2016
120	Badarnah L.	Water Management Lessons from Nature for Applications to Buildings	2016
121	Okoye C.O., Solyali O., Akintuğ B.	Optimal Sizing of Storage Tanks in Domestic Rainwater Harvesting Systems: A Linear Programming Approach	2015
122	Vialle C., Busset G., Tanfin L., Montrejaud-Vignoles M., Huau M.-C., Sablayrolles C.	Environmental Analysis of a Domestic Rainwater Harvesting System: A Case Study in France	2015
123	Stratigea D., Makropoulos C.	Balancing Water Demand Reduction and Rainfall Runoff Minimisation: Modelling Green Roofs, Rainwater Harvesting and Greywater Reuse Systems	2015
124	Feki F., Weissenbacher N., Assefa E., Olto E., Gebremariam M.K., Dalecha T., Shibru B., Sayadi S., Langergraber G.	Rain Water Harvesting as Additional Water Supply for Multi-Storey Buildings in Arba Minch, Ethiopia	2015
125	Lash D., Ward S., Kershaw T., Butler D., Eames M.	Robust Rainwater Harvesting: Probabilistic Tank Sizing for Climate Change Adaptation	2014
126	Rahman S., Khan M.T.R., Akib S., Din N.B.C., Biswas S.K., Shirazi S.M.	Sustainability of Rainwater Harvesting System in Terms of Water Quality	2014
127	Liaw C.-H., Chiang Y.-C.	Framework for Assessing the Rainwater Harvesting Potential of Residential Buildings at a National Level as an Alternative Water Resource for Domestic Water Supply in Taiwan	2014
128	Zeleňáková M., Markovič G., Kaposztásová D., Vranayová Z.	Rainwater Management in Compliance with Sustainable Design of Buildings	2014
129	Dao A.-D., Nguyen V.-A., Han M.	Benefit of the Drinking Water Supply System in Office Building by Rainwater Harvesting: A Demo Project in Hanoi, Vietnam	2013
130	Matos C., Santos C., Pereira S., Bentes I., Imteaz M.	Rainwater Storage Tank Sizing: Case Study of a Commercial Building	2013
131	Fulton L.V., Musal R.M., Mediavilla F.A.M.	Construction Analysis of Rainwater Harvesting Systems	2012
132	Kim M., Ravault J., Han M., Kim K.	Impact of the Surface Characteristics of Rainwater Tank Material on Biofilm Development	2012
133	Gomez-Ullate E., Novo A.V., Bayon J.R., Hernandez J.R., Castro-Fresno D.	Design and Construction of an Experimental Pervious Paved Parking Area to Harvest Reusable Rainwater	2011
134	Reitano R.	Water Harvesting and Water Collection Systems in Mediterranean Area. The Case of Malta	2011
135	Sheng L.X., Mari T.S., Mohd Ariffin A.R., Hussein H.	Integrated Sustainable Roof Design	2011
136	Chanan A., Vigneswaran S., Kandasamy J.	Valuing Stormwater, Rainwater and Wastewater in the Soft Path for Water Management: Australian Case Studies	2010

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE
TITLE			
Title	1	Identify the report as a scoping review.	1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	1-2
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	3
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	4
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	5-6
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	4-6
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	5-6
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	5-7
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	6-22
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	11-22
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	4, 31
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	8-30



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Figure A1. Cont.

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	5-7
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	33, Appendix 1 Table A1
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	Not Applicable
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	8-30
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	30-31
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	30-31
Limitations	20	Discuss the limitations of the scoping review process.	31
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	30-31
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	31

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.
 * Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.
 † A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).
 ‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.
 § The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).



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Figure A1. PRISMA-ScR-Checklist [31].

References

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