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QUALITATIVE RESEARCH CHALLENGES IN ASSESSING RAINWATER HARVESTING IMPLEMENTATION FIDELITY FOR RELIABLE DATA

Hafizah Mohd Latif[1], Norazida Mohamed[2], Sohrab Donyavi[3], Noor Sahidah Samsudin [4]

[1,4] *School of Construction & Quantity Surveying, College of Built Environment*
UNIVERSITI TEKNOLOGI MARA, SHAH ALAM, SELANGOR, MALAYSIA
[2]*Faculty of Accountancy,*
UNIVERSITI TEKOLOGI MARA, SHAH ALAM, SELANGOR, MALAYSIA
[3]*School of Architecture, Computing and Engineering,*
UNIVERSITY OF EAST LONDON, UNITED KINGDOM

Abstract

Assessing local councils' adherence to rainwater harvesting policy regulated in the by-laws is critical to the success of water conservation efforts. However, there are certain challenges that must be addressed in this assessment. This paper highlights the aforementioned challenges and provides recommendations for future research. The research used a qualitative approach, employing six distinct methods to obtain more robust and reliable data: (i) desk study, (ii) document review, (iii) interviews, (iv) observation, (v) self-analysis questions and (vi) focus group discussion. The success of the implementation-focused research was based on a defined direction of assessment, eligible participants and sites, suitable methods, access to reliable data, robust analysis and writing proficiency. This paper suggests that future search should focus on establishing relevant skills, building relationships with the participants, defining concepts and exploring alternative data sources. Assessing implementation fidelity was not easy because it necessitated substantial resources to draw meaningful conclusions about the extent to which the rainwater harvesting policy was delivered. Addressing qualitative research challenges in assessing rainwater harvesting implementation could enable researchers to suggest implementers on making more informed decisions in attaining Sustainable Development Goal 6.

Keywords: Implementation Fidelity Assessment, Rainwater Harvesting, Research Methods, Policy

[1] Corresponding author email: hafiz017@uitm.edu.my

INTRODUCTION

With the exacerbation of water scarcity, an increasing number of nations are adopting rainwater harvesting as a viable and sustainable approach to address their water needs. While rainwater harvesting has potential advantages, such as reducing floods and decreasing reliance on municipal water supplies (Azis et al., 2021; Habibullah et al., 2023), a paucity of assessment of the implementation of rainwater harvesting policies by local councils in many regions remains (Suki et al., 2022). The lack of assessment raises concerns about the effectiveness of these policies, known as implementation fidelity or alternatively referred to as integrity (Carroll et al., 2007). Implementation fidelity refers to the extent to which an intervention, policy or programme is carried out in accordance with its intended protocol (Carroll et al., 2007). Assessing fidelity is crucial for understanding the implementation of programmes or policies in real-world settings (Durlak & DuPre, 2008). This allows for the identification of programme components that were present or absent, as well as any deviations, changes or omissions to improve current recommendations and achieve better outcomes (Mowbray et al., 2003).

However, despite the theoretical advancements of implementation fidelity, there is still a significant gap in research assessing the practical implications and real-world phenomena of rainwater harvesting policy adherence (see: Suki et al., 2022). Addressing the noted gap, this paper discusses the academic challenges in the process of assessing rainwater harvesting implementation fidelity. It delves on maintaining consistency between the theoretical framework adopted from the implementation science field and its application in practice, while also identifying key barriers. By highlighting these challenges, this paper aims to provide insights and recommendations for improving the rigour and relevance of future research. This increases the odds of discovering intriguing discoveries in various contexts and offers knowledge on implementation fidelity, allowing researchers to provide more informed guidance to implementers in making decisions that cater to the needs of diverse communities.

COMPONENTS OF ASSESSMENT

The assessment of implementation fidelity provides a comprehensive understanding of what is happening in the programme and how successful it is, which helps eliminate incorrect assumptions (Carroll et al., 2007), such as a programme's success is being greater than what it actually is (O'Donnell, 2008). According to Dane & Schneider (1998), fidelity is commonly defined in terms of five quantifiable dimensions in the health-related research: (i) adherence, (ii) dosage, (iii) intervention quality, (iv) participant responsiveness, and (v) programme differentiation. Until now, no research in built environment or

implementation policy has assessed all five aspects of fidelity. Nonetheless, to better suit the context of this research, the frameworks proposed by Allen et al. (2012) were adopted and integrated with the relationship between concepts depicted by Carroll et al. (2007). By having components from the frameworks selected and pre-determined, it facilitated the assessment of whether the by-laws were implemented as intended.

METHODS AND MATERIALS

Assessment of implementation fidelity can be carried out using a variety of approaches, among the most prevalent of which are the quasi-experiment, the activity, the questionnaire survey, the interview, the document review, the observation, the focus group discussion (see: Suki et al., 2022) and self-assessment questions (see: O'Donnell, 2008). In addition to employing self-assessment questions, interviews and focus group discussions, this study incorporated other qualitative approaches, including document review and observation, to enhance the accuracy and reliability of the collected data. A combination of methods was necessary to provide a comprehensive assessment of implementation fidelity.

In this research, the methods for assessing implementation fidelity were selected based on the research questions, the resources available and the intended audience. In-depth case studies were conducted to assess the relationship between rainwater harvesting implementation strategies and fidelity in six Perak local councils. This has provided rich and thorough information on the implementation process and the factors that influence fidelity. The methods below were used to collect data.

Desk study: Desk study was conducted to collect information on six local councils, with the aim of identifying their leaders in order to facilitate the process of obtaining permission to participate in the research. Additional information obtained from the councils' websites encompassed by-laws, checklists for the rainwater harvesting process as well as related practices.

Interview: The research utilised organisational charts to locate department heads in local councils for interview sessions. Participants were identified based on nonprobability purposive sampling and contacted via email or in person. Semi-structured interviews were conducted to understand their abilities, opinions, work duties and resources in performing public enforcers duties. Building and engineering department heads were interviewed to understand rainwater harvesting from local councils' perspectives. The interviews covered the department's process from applicant submission plans to project handover. The recorded sessions were transcribed for analysis.

Document review: The research analysed implementation records, including rainwater harvesting projects, building approval processes and the by-

laws. Data was gathered from participants or their websites during desk studies, interviews or after the interviews ended and recorded. Construction project details, such as applicant's drawing plans and site visit reports, were also analysed to determine local councils' adherence to by-laws.

Self-assessment questions: Self-assessment questions were structured to help participants in assessing their competence and form judgements about their organisational strategies and implementation outcomes. The questions were divided into three sections, based on the research's conceptual framework. In addition to the participants interviewed, others contributed to the implementation of rainwater harvesting were identified using the snowball sampling technique.15 individuals from six local councils completed the self-assessment, identifying strengths, gaps and areas for improvement. The responses were analysed using a content analysis approach with pre-identified themes.

Observation: Observation involved directly observing the local councils' practices in rainwater harvesting, recording information and practices for each visit. Participants' attitudes towards rainwater harvesting were recorded. Site visits were conducted after self-assessment questions were collected. Furthermore, each council provided details of projects required by the by-laws to install rainwater harvesting systems. The observation provided a unique perspective on on-site activities and how councils handled the implementation of designs. Conversations with houseowners were also conducted where possible. Pictures of rainwater harvesting systems were taken using a Sony A6000 digital camera. The observations and conversations were recorded in a diary.

Focus group discussion: Focus group discussion was used as a method at the end stage of the current research for more in-depth discussions between the governmental and academic professionals. All local councils and four research team members were invited to participate, with details provided three weeks in advance. Two councils were unable to participate due to conflicting dates and lack of employees. Three other councils, including four research team members, attended the discussion, which lasted about 2 hours with a break. Viewpoints and disagreements were recorded using a Sony A6000 digital camera, an Apple iPhone 12 and written notes. The discussion took place at Cempaka Hall, D'Hotel Seri Iskandar, on 11 January 2023, from 10am to 12pm.

FINDINGS

Implementation fidelity assessment was a difficult task because it required determining how closely a programme or intervention is being carried out in accordance with the intended policy as stated in the by-laws. The task of collecting qualitative data on fidelity implementation from six local councils was peculiarly more difficult because it involved different environments, approaches, sites and individuals. This required a careful planning, execution and analysis.

Below are some inevitable challenges that other implementers and researchers may want to take into consideration in ensuring that the collected data are able to answer the research questions, utilise resources and maintain participant confidentiality.

Challenge 1: Acquiring a clear framework for fidelity assessment.
There is currently no framework or methodology being used to evaluate the output fidelity with which local councils implement rainwater harvesting policies. Most of hundreds available fidelity assessment frameworks and models were derived from implementation science, which included several components such as the evaluation of implementation outcomes (e.g.: fidelity, acceptability, and sustainability) and the use of implementation strategies (e.g.: individual competency, organisational factors, and interventions that influence implementation success). This necessitates a thorough grasp of the research problem, aim and research questions to match the existing frameworks, each of which has a unique research design and emphasis. Consequently, it was essential to conduct a thorough search, categorise and match components from various frameworks in different areas of implementation studies in order to refine and align the research design.

Subsequently, the research incorporated essential components from the frameworks proposed by Allen et al. (2012) and Carroll et al. (2007). A case study approach was then carried out at a local council in a state in Malaysia between 2020 and 2021. The framework used was extended based on the findings and used in this current research. The framework deconstructs the implementation fidelity assessment into its constituent components, with rainwater harvesting policy as input, implementation strategies as determinants and fidelity as output. The extended conceptual framework provided a logical foundation for relationships between concepts and guided data collection; however, it still posed challenges in understanding a complex issue in its real-life context.

Challenge 2: Identifying eligible participants and sites.
Approaching the leaders of local councils (the district officer or the president) to participate was challenging because email communications were ineffective for some of them. A meeting was scheduled at their workplace and the councils were persuaded to participate due to their public services and awareness of the research's benefits. Their agreement was contingent on privacy and confidentiality assurance, ensuring anonymity for the councils and participants. Confidentiality was crucial as organisations prefer not to reveal their internal processes to the public.

Identifying eligible participants for interviewing regarding the implementation of rainwater harvesting proved to be difficult following the

leaders' endorsement. The number of employees involved in rainwater harvesting implementation varied across local councils, depending on their respective responsibilities and departments. It required considerable effort to persuade them to allocate time for interviews once they were identified, and a few of them did not reply to emails. Thus, the identical approach of conducting face-to-face meetings was utilised. The process of scheduling a meeting was time-consuming and could span several weeks.

Regarding the eligible sites, it was necessary to select completed residential projects so that the outcomes of the local councils' implementation practices could be assessed. The sites they were either suggested by the participants or selected from lists of previously completed projects. There were only a limited number of sites that met the requirements outlined in the by-laws for the installation of rainwater harvesting systems. Thus, a comprehensive analysis and comparison also became restricted. Critical analysis skills were required to correspond data from various sources with limited access.

Challenge 3: Having a skilful research assistant.

Proficient data collection and analysis necessitate a certain level of skills to accurately assess fidelity. It was challenging to constantly educate a research assistant who lacked knowledge and skills in qualitative methodology and research design. The expert research members had to also allocate ample time to review, correct and develop the interview questions to ensure they were open-ended, clear and worded in a manner that fostered a sense of acceptance among participants. Following that, the research assistant required explicit guidance regarding the significance of the developed questions in eliciting information about core beliefs and values, while also indirectly addressing sensitive issues concerning the by-laws adherence and understanding the rationale behind specific actions. This understanding was crucial for the participants to be able to provide impartial and more inclusive responses.

In the initial interview sessions, the research assistant encountered difficulty in promptly processing information and adapting in real time. He experienced uncertainty to be critical while remaining neutral and struggled to make sense of the participants' explanations, thus labelled them as vague. This had restricted his ability to probe questions, particularly when the participants appeared to be lacking knowledge about the topic of rainwater harvesting policy/ programmes or were not accustomed to explaining their tasks verbally. Therefore, the research assistant required instruction from the expert research members so that he could be intuitive about how things were related. As a result, several different interview sessions with probing questions had to be re-scheduled. Due to the inability of the assistant to independently develop questions with the

aforementioned targets, the research members also had to review, correct and develop questions for self-assessment, which was time-consuming.

The research assistant also lacked independence, English proficiency, interpretation and reading, necessitating repeated instruction. This required the expert research members to put in more time and efforts to improve his skills through a series of discussions and brainstorming sessions in which questions about the findings were asked at various stages of data collection. Given the iterative nature of qualitative research, the assistant had the chance to ask questions and seek clarification from the expert research members at any stage of data collection and analysis. Nonetheless, the research assistant was self-sufficient in utilising NVivo to analyse data and knew how to quickly establish rapport with participants to gain trust, which aided in data collection at various times. These skills are critical for conducting successful qualitative research, but they can be challenging for individuals who are new to the stance.

Challenge 4: Gaining satisfactory access to data.

This study followed the research ethics protocol, in which informed consent was obtained, confidentiality was maintained, and the data was promised to be used only for legitimate research purposes. The data collected was ensured to be obtained in an ethical and dignified manner for the participants. However, due to confidentiality, gaining access to certain data was unattainable (such as audit report). Some other data were also inadequate and not readily available, either because they did not exist (such as interventions), or because the data were not documented (such as participants' own efforts in rainwater harvesting). These had limited the ability to fully analyse implementation fidelity and jeopardised the validity and reliability of the findings. As a result, different methods were required to provide rich descriptions of these complex issues to provide scientifically sound findings.

Challenge 5: Choosing the right qualitative methods.

Choosing the optimal qualitative methods and determining the impacts they may have on this research was a challenging task because they affect the reliability and validity of the collected data. A review of previous studies on implementation fidelity to the scope of this research were referred (see: Suki et al., 2022) to inform and support the method selection. This is important because using incorrect method to address a research question can waste time and resources. Table 1 summarises the purpose of selecting each method. It also shows the method-related challenges encountered throughout this research that reflect the limitations and justifications for using multiple methods.

Table 1: Qualitative method-related challenges in assessing implementation fidelity.

Methods	Purpose	Challenges
Desk study	To gain fast insights into case studies to help overall investigation at different local councils (through their websites)	Data was limited at providing a complete understanding of processes and individuals. Links to relevant documents on a few websites were inaccessible, resulting in inadequate information. Some of the data on the websites had not been updated (such as the contact person).
Interview	To encourage participants to share useful information in their own words	Several participants were unaware of the contents of the by-laws rainwater harvesting sections and/or the system itself. There were just a few employees in charge of the implementation in each council. Shallowness of answer necessitates more probing questions. Time-consuming.
Document review	To obtain data and/or structured information about strategies and fidelity. Documents were also compared to support data obtained through other methods	Attachments and contents in some documents were incomplete. Missing or non-updated records were still utilised for reporting. Researchers had to be critical and more thorough in gaining essential information. Several other documents were lengthy, making it time-consuming to analyse sections pertaining to rainwater harvesting implementation.
Observation	To gather real-world data on how rainwater harvesting was implemented	Needed skills to make sense of the data in real time. The researchers had to communicate often to interpret circumstances. Only specific sites that were informed by the councils can be observed, restricting the random observation, which may be more fruitful. Costly and time-consuming.
Self-assessment questions	To allow participants to make judgements about the implementation strategies and fidelity	Questions had to be carefully developed to focus on positive traits and achievements, which was necessary to demonstrate the strengths/weaknesses of the strategies and fidelity output. It was challenging to assess and extract meanings from the self-assessment questions so that conclusions could be drawn. Inappropriate answers to questions.
Focus group discussion	To explore the local councils' interests and suggestions for enhancing the rainwater harvesting implementation, as well as their expectations from the academic field	Three local councils were unable to participate, limiting the ability to gain additional insights. A few participants seemed unwilling to voice their concerns due to different practices. Researchers recognised the issue and quickly established rapport during the break so that the participants felt at ease. Costly and time-consuming to gather participants from all six local councils.

Challenge 6: Writing for publications.

The built environment encompasses buildings, infrastructures, urban spaces and landscapes, involving builders, engineers and architects who mostly collect data in experimental or survey settings for measurable numerical results. Implementation research, on the other hand, collects qualitative data through open-ended methods such as interviews, focus groups and observations. This data is subjective and provides insights into the attitudes, underlying causes and motives. It was challenging to utilised qualitative data in the built environment field as it did not provide quantitative evidence that many built environment publications and practitioners seek. This necessitates the use of alternative data representation, such as visualisations to illustrate the findings in a more

meaningful way to them. However, the findings of this research were not easily visualised due to complexity and richness of data. Whilst words provide valuable insights and can be summarised and illustrated, visualisations are not always necessary. Unfortunately, the inclusion of data visualisations in qualitative manuscripts is often misunderstood by a significant number of reviewers.

In general, qualitative research entails a greater volume of written content due to its reliance on subjective data that is susceptible to interpretation. Words, in fact, are qualitative data. While several publications in the field of built environment acknowledged this effort by permitting qualitative manuscripts to have a higher word count, this might not be sufficient to meet the expectations of built environment reviewers with diverse quantitative expertise, who may provide feedback on aspects that qualitative authors are unable to deliver. For instance, several Scopus-Indexed reviewers rejected two manuscripts from this research, stating that "there is no statistical data", "no analysis or numerical data processing has been presented in this article, which diminishes the authors' work in this regard" and "the absence of statistical analyses, graphical representations, or other visual aids to complement the data further weakens the impact of the results". Consequently, the authors had to use more words to convey the broad grasp of the qualitative approach. As much as the authors expected the quantitative reviewers with opposing stance to comprehend the qualitative perspectives, they had the responsibility to explain research design adequately without making the paper lengthy. This task presents a challenge and emphasises the authors' need for skill in writing, specifically in effectively explaining the findings and meticulously drawing conclusions.

RECOMMENDATIONS AND DISCUSSIONS

The findings highlight the significance of clearly defining and measuring the various components of fidelity assessment prior to collecting data. This is crucial to maintain consistent fidelity assessment across different implementation studies. The task of developing a framework to analyse concepts and their interactions was challenging because there were numerous existing frameworks and models especially in the dissemination and implementation research. Additionally, it was difficult to ascertain how well rainwater harvesting practices align with the framework adopted. Hence, it is recommended that a clear unit of analysis is determined.

The unit of analysis is a crucial element in research, defining the scope and concepts involved. It aids in data collection and analysis while maintaining a contextually rich and broad unit of analysis (Roller & Lavrakas, 2015). Research questions are central to determining the unit of analysis, allowing for the recording of understanding, experience, meanings and stories (DeCarlo, 2018). For instance, one of the questions in this current research is "How do local

councils allocate resources to implement legislative regulations on rainwater harvesting?", needing the organisation as the unit of analysis. Employees, who work for the organisation and have access to data, become the unit of observation, allowing for the collection of various types of data and the selection of research methods.

Furthermore, it is also critical to ensure that the research questions are clearly stated so that an appropriate framework/ model/ theory and methodology can be fit for answering them. It will then progress to sample selection, which presents another challenge for fidelity assessment because identifying individuals who involved in the implementation require a clear inclusion and exclusion criteria (Patino & Ferreira, 2018). Proper sampling ensures data reliability in answering the research questions (Etchells & Woodcock, 2018). Inclusion criteria enable the identification of those who involved in the process of rainwater harvesting policy adherence, while exclusion criteria exclude factors that may impact outcome parameters as recognised by Patino & Ferreira (2018), such as employees involved in rainwater harvesting only for the local landscape irrigation.

Due to the fact that different concepts contributes to fidelity, the ideal fidelity assessment methods should be multidimensional (An et al., 2020). As qualitative research continues to gain traction in the implementation studies, it is critical to understand its strengths and weaknesses as a methodology. Qualitative methods enabled this research to obtain first-hand knowledge that captured crucial aspects required for interpretation. Furthermore, qualitative research allowed the exploration of a complicated phenomenon that would otherwise remain unseen due to its observational nature. It is highly recommended that multiple qualitative methods or triangulation is employed to get meaningful insights into dynamics driven by organisational contexts or individuals. Triangulation designs have the ability to identify agreement and validation of findings through various research methods (Hanson-DeFusco, 2023). In this research, the triangulation of document review, interview and observation helped to build understanding of the overall scenario. Miles et al. (2018) emphasised that some advantages of triangulation include allowing creativity in collecting data, offering more assertion in the findings, leading to richer data, allowing for integration of theories, reduce research bias from a single method and uncovering limitations. In other words, integrating the findings of the different research methods helps to validate the results and provides a stronger basis for analysis and interpretation. When several research methods yield the same conclusion, researchers can be more confident in the findings.

However, out of the methods employed, this research has been unable to establish that the self-assessment-questions were useful, similar to the finding of (Noell et al., 2005), and contrary to the claim that it is beneficial because it

requires the individual to be honest as claimed by Khoury et al. (2019). In this research, the selection of supporting roles in answering the questions were less promising because they did not have the necessary information to provide honest feedback. Furthermore, a significant proportion of the participants' responses did not accurately reflect some of the observed practices. This is supported with research that suggests self-assessments are less successful (Fiske, 2008) because the level of fidelity was found higher than what has been observed (O'Donnell, 2008), indicating biasness in the method. Hence, it seems reasonable to infer that self-assessments may not be reliable in assessing fidelity and that other methods should be considered when conducting implementation fidelity, particularly in the built environment discipline.

One condition of applying qualitative methods was that it required "detective-like" skills to search something like puzzle pieces that fit into the overall jigsaw. With this in mind, it was challenging to ensure that the research assistant had a honing set of skills to strengthen the findings of this research. To accomplish that, the assistant was consulted by the experienced research team to develop his critical thinking and analytical skills. To improve his analytical skills, he was taught to pay attention to details and be observant because it allowed him to process the way things work and interact. For the critical thinking part, the assistant was advised repetitively to read more about dissemination and implementation materials, practise empathy, practise active listening, be curious, and gather more information as necessary. These skills were developed mainly through frequent communications during and after each data collection made between the research assistant and research members, especially the lead researcher, to discuss the findings and interpretations. The research assistant also attended relevant courses (NVivo) and performed own knowledge searching especially through YouTube videos to increase his ability in data analysis.

Proficiency in qualitative writing is necessary since it involves an immense amount of complex data, in words. Depending on the context of publication, visualisations such as word clouds, word streams, mind maps, and Venn diagrams may help in the assertion of qualitative results (Nguyen et al., 2021). However, in accordance with the current research, Stikeleather (2013) argued that not all data is appropriate for visualisations because they could not present the complexity of the data set, which leads to misunderstandings and wrong conclusions. Visualisations should thus only be used sparingly and when they may truly aid in the comprehension of the contents. Outweighing that, researchers should pay close attention to explicitly state the methodologies they used because qualitative research is often criticised for having unclear methodology boundaries and being inapplicable to a broader population (Miles et al., 2018). Because the implementation research is a complex subject, it would be beneficial to use a reporting criteria to ensure that the research is conducted

within the standard understanding (Colquhoun et al., 2014). For example, in this research, the Standards for Reporting Implementation Studies (StaRI) checklist developed by Pinnock et al. (2017) was adopted to ensure that the research is reported in a clear and transparent manner. The checklist, while being extensively used in the medical field, was helpful in identifying the scope and limitations of the research design as well as in understanding the difference between reporting on implementation strategies and reporting on implementation interventions. Therefore, to ensure reliable and trustworthy data, it is crucial for researchers to develop a consistent reporting method. This is a distinct topic that calls for a more detailed discussion.

CONCLUSIONS

Rainwater harvesting is an essential strategy for water conservation, particularly in regions with scarce water resources. Local councils have an important role in the implementation of rainwater harvesting policy. Their fidelity in implementing this policy has a substantial influence on the success of rainwater harvesting initiatives. However, this research suggests that assessing the fidelity of local councils is not an easy task. This paper aims to identify the challenges associated with assessing the fidelity of local councils in the implementation of rainwater harvesting policy.

This research revealed challenges in conducting assessments in different disciplines of study, which generally include concerns about the consensus of concepts, confidentiality, critical, analytical skills, as well as access to data. The research has also shown that the methods used to assess implementation fidelity differed in their strengths and weaknesses. Identifying appropriate methods necessitated thorough consideration of the context, the complexity of the situation, and resources available. While being widely used to measure fidelity, self-assessment-questions were found to be unsatisfactory for the context of this research – which focused on overall strategies rather than interventions alone. On the other hand, triangulation of observation, document review and interview have confirmed convergence, complementarity and dissonance of the findings.

Overall, identifying research challenges is important as it provides insights into potential obstacles and allows the development of alternatives ahead of time. It can also uncover any previously overlooked linkages and definitions between concepts that could lead to substantial results. To be more robust in their research methodology, researchers may ask questions such as: "Who will be the participants?", “How will the data be collected?”, “When and how will the data be analysed?”, “What abilities do the research necessitate?”. As a result, objectives and methodology may be refined further by knowing which methods are most suited and how resources and availability may influence outcomes.

Since the research was limited to uncovering the local councils' implementation at organisational level, it was not possible to investigate the perspectives of other external stakeholders, such as rainwater harvesting suppliers, developers and end-users. This hampered a formation of a comprehensive understanding of fidelity. External perspectives regarding the processes of adhering to the rainwater harvesting by-laws that require interaction with local councils for the installation and use of the system, may reveal obstacles that impede effective implementation. Hence, it becomes essential to promote more rigorous and systematic research to assess the implementation of rainwater harvesting that may currently be lacking in these areas. The assessment can help local councils in becoming more transparent and accountable by identifying areas to be improved and areas that are doing well.

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