Systematic Scientific Journal
ISSN: 2675-521

ECONOMIC ANALYSIS OF THE IMPLEMENTATION OF RAINWATER HARVESTING SYSTEMS IN HOMES

https://doi.org/ 10.56238/rcsv15n3-010

Submitted on: 02/21/2025 **Approved on**: 03/21/2025

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ABSTRACT

The global water crisis, aggravated by climate and population factors, drives the search for sustainable solutions to optimize water use. Among these alternatives, rainwater harvesting emerges as an efficient strategy to reduce dependence on conventional sources and minimize supply costs. Studies show that up to 40% of residential demand can be met by this source, providing economic and environmental benefits. However, the feasibility of implementing these systems depends on initial investments in infrastructure and ongoing maintenance to ensure water efficiency and quality.

Keywords: Rainwater harvesting. Water crisis. Sustainability. Economic viability. Water efficiency.

INTRODUCTION

The growing global water crisis, intensified by climate change and population growth, has encouraged the development of sustainable alternatives for the efficient use of water resources. In many regions, the overload on urban supply systems has led to an increase in water tariffs, making it necessary to adopt measures that reduce dependence on conventional sources. Among these solutions, rainwater harvesting stands out as a viable strategy from both an environmental and economic point of view (GUIMARÃES, 2018; FUGI, 2019).

The economic viability of rainwater harvesting systems is a crucial aspect to be considered by consumers and public managers. Studies indicate that approximately 30% to 40% of the water used in homes can be replaced by rainwater, significantly reducing supply costs (MELO, 2022; BERTOLAZZI; CUSTÓDIO, 2020). However, the implementation of these systems requires initial investments in infrastructure, such as reservoirs, pipes, and filters, as well as maintenance costs to ensure the quality of the stored water and the efficiency of the system (SILVA, 2024).

In view of this scenario, this study analyzes the economic feasibility of implementing rainwater harvesting systems in homes, comparing different case studies and discussing the financial and environmental benefits obtained from this technology.

Different studies have been conducted to evaluate the economic feasibility of rainwater harvesting systems in homes. Fugi (2019) analyzed the implementation of a system in Blumenau-SC and found an average saving of 37.90% in drinking water consumption, with a variation between 18.76% and 58.06%, depending on the consumption pattern of the residence. The estimated payback time ranged from 6 to 10 years, depending on the volume of water abstracted and the local cost of the water tariff.

In the study by Guimarães (2018) in Uberlândia-MG, the results indicated that due to the low water tariffs in the region, the return on investment in rainwater harvesting systems may exceed the useful life of the equipment, making the implementation less attractive from a strictly financial perspective. However, by incorporating tax incentives and subsidies, the return could be accelerated, as demonstrated by Melo (2022), who studied a system in Goiânia-GO and found an estimated *payback* of 8 years.

Bertolazzi and Custódio (2020) investigated the effectiveness of a hybrid model that combines rainwater harvesting systems with energy-saving devices, such as aerators and dual-flush valves. This study demonstrated that financial savings can be increased when these systems are adopted together, achieving reductions in drinking water consumption of more than 50%.

Figure 1 presents a comparison of the return on investment time in different scenarios of water consumption and tariff.

The results obtained by Silva (2024) show a significantly longer payback on investment time (64 years) compared to other studies, which vary between 6 and 15 years. This difference can be explained by several technical and economic factors:

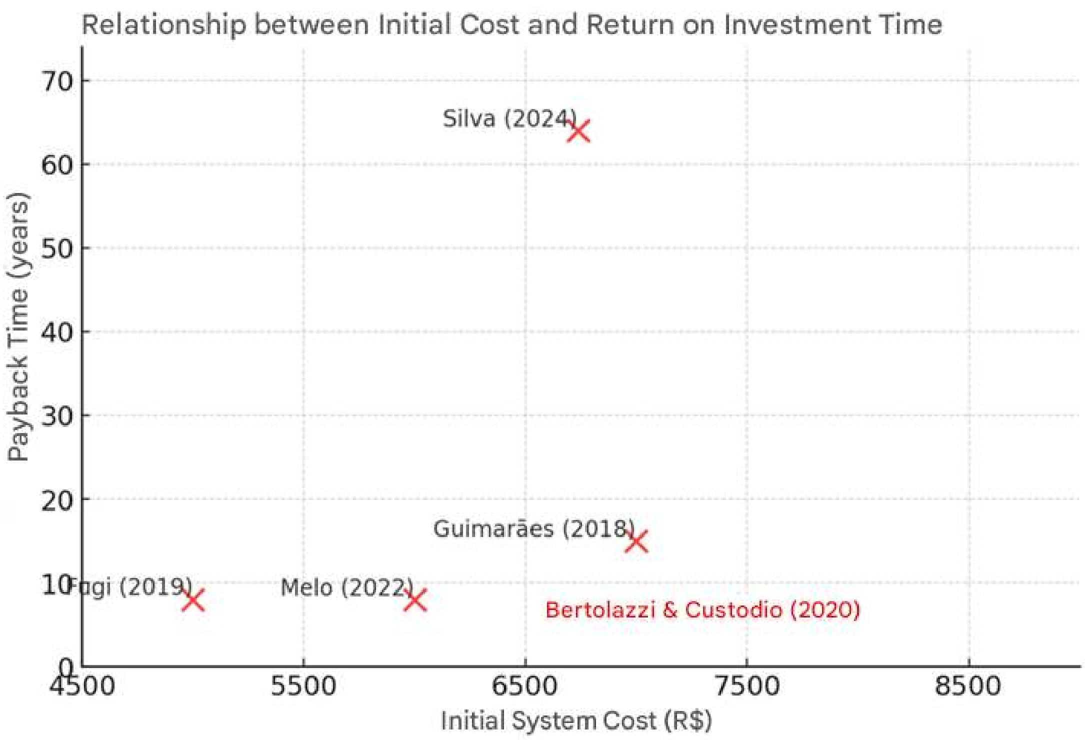
1. Low Monthly Savings Provided by the System
   - The study by Silva (2024) showed that the monthly savings generated by the rainwater harvesting system was only R$ 8.84 per month, which represents a reduction of only 3.5% in total water consumption.
   - In contrast, Fugi (2019) found average savings of 37.9% in drinking water consumption, resulting in a faster recovery of investment.
2. High Implementation Cost
   - The study by Silva (2024) indicated an initial cost of R$ 6,736.35 for the installation of the system, which, considering the low monthly savings, significantly extends the return on investment time.
   - In studies such as Melo (2022) and Fugi (2019), the initial cost of the system was similar, but the savings generated were much greater, allowing for faster *payback*.

3. Destination of Stored Water
   - Silva (2024) designed the system to supply only general-purpose taps, which represent a small percentage of total residential water consumption (about 3.5%).
   - Other studies, such as that of Bertolazzi and Custódio (2020), included toilet flushes and hybrid systems with energy-saving devices, increasing savings and reducing turnaround time.
4. Water Tariffs in the Study Region
   - Silva's research (2024) was carried out in Goiânia, where the water tariff of SANEAGO (state company) is not as high as in cities like Blumenau (study by Fugi, 2019).
   - Guimarães (2018) also observed that, in Uberlândia, the return on investment was less advantageous due to the low water tariffs in the region.
5. Precipitation Volume and System Efficiency
   - The city studied by Silva (2024) has prolonged dry periods, which limits the capture and continuous use of stored water.
   - In comparison, Fugi (2019) and Bertolazzi and Custódio (2020) analyzed cities with high rainfall and distributed throughout the year, increasing the efficiency of the system.

The studies analyzed demonstrate that the economic viability of rainwater harvesting systems depends on variables such as the volume of precipitation, the consumption pattern of the residence, the cost of the water tariff, and government incentives. In regions with high water tariffs and high rainfall, the return on investment time tends to be shorter, making the system more financially advantageous.

Comparative analysis between different studies also suggests that combining rainwater harvesting systems with other water-saving measures can enhance the financial benefits. In addition, the implementation of public policies aimed at encouraging this technology is essential to make these systems more accessible and economically viable on a large scale.

The graph in Figure 2 illustrates the relationship between the initial cost of the system and the time to return on investment in different tariff scenarios.



The economic analysis of the implementation of rainwater harvesting systems shows that this technology can be financially advantageous, especially in places with high water tariffs and adequate precipitation volume. The savings generated can significantly reduce supply costs over the years, making the investment attractive for both single-family homes and larger developments.

However, to expand adherence to this solution, governments and institutions must offer financial incentives, such as subsidies and tax reductions, as well as awareness campaigns about the benefits of rainwater harvesting.

In this way, rainwater harvesting is an economically viable and environmentally sustainable strategy, contributing to water security and efficiency in the use of natural resources.

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