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Use of rainwater and conflict of interest between concessionaires, consumers and the state in the context of Rio de Janeiro

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ABSTRACT
The use of rainwater has vast potential and is a fundamental and necessary measure, but low development is evidenced by the low visibility of those who implement it and a series of difficulties for its implementation. Intuitively, the implementers make use of a logic of the need and absence of distribution concessionaires such as the hinterland, not just the northeast. Billing is the source of revenue for concessionaires and is incremental, where those who consume the most pay for the value of the m³ consumed. Therefore, reducing consumption by billing is conflicting with the loss of revenue and for this reason this article seeks to highlight the fact of the loss of revenue by distributors with values, simple ideas and logical reasoning in order to prospect the result of the development of a rainwater reuse system by an average consumer.

Keywords: Conflict of interest, Rainfall, Utilization.

INTRODUCTION

The potential for rainwater harvesting in buildings is demonstrated and presented by a series of authors such as TAVARES (2019), CAPELIN (2018), BRITO (2020) and SANT'ANA (2023), standardized in the form of ABNT NBR 15527 and not legalized in the form of the Law of the State of Rio de Janeiro No. 9,164 of December 28, 2020.

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Article 3 of Fluminense Law No. 9,164 of December 28, 2020 rules out the possibility of reusing rainwater in the building as follows and with the appropriate italics:

> "Art. 3 The rainwater retardation reservoirs, theoretically, not usable for non-potable purposes will be destined for their temporary accumulation and subsequent discharge into the public rainwater network."

The energy sector has about the energy matrix of Brazil, but in the water scenario the same increase in data is not observed, generating omission regarding the use of rainwater in the Brazilian scenario and fostering a series of reflections and questions such as the fact of the full use of this model in scenarios such as the hinterland, not only northeastern and its impact.

Taking advantage of rainwater reduces the drainage flow, optimizes the respective curve in favor of non-flooding, increases the concentration time, expands the water matrix, reduces the risk of water shortage in the event of an accident, improves air quality by washing the air and increasing humidity and makes it possible for more people to have supply through the same distributed flow, however, it considerably reduces the revenue of the concessionaires due to the financial gain and greater need for a distribution line, generating a conflict of interest object of this work.

The object of any profitable business is to do more with less and make as much money as possible by applying the least investment necessary. In view of this logic, the higher the unit revenue of each customer, the lower the need to develop distribution lines to serve more customers than in the event of an increase in unit value to the increase in consumption, the operation by the concessionaire becomes more profitable.

Therefore, the perspective and logic adopted is not to expand the distribution network by the distributor but to increase the unit consumption or proceed with the grouping of consumers causing the unit value of the m^3 consumed to be higher, which is why the measurement of several buildings should be carried out collectively to the maximum (building) in relation to individual measurements or even by being accompanied by a series of risks such as water use according to the legislation in force in the State of Rio de Janeiro.

OBJECTIVE

The objective of the present work is to discuss the conflict of interest of the incremental billing model in relation to the use of rainwater carried out by consumers, presenting through basic and intuitive calculations the losses to the detriment of the concessionaires and the advantage with economic prominence in favor of the consumer and society in a reflexive way.

SCENARIO AND JUSTIFICATION

The Guandu (western portion) and Imuna-Laranjal (eastern portion) systems are the two preponderant and majority water treatment systems in the metropolitan region of Rio de Janeiro. Guandu, coming from the transposition of the Paraíba do Sul River, supplying the city of Rio de Janeiro (capital of the State of Rio de Janeiro), part of the Baixada Fluminense with emphasis on municipalities such as Nova Iguaçu and Duque de Caxias, as well as municipalities such as Itaguaí. While Imuna-Laranjal, the eastern metropolitan portion, supplies water to cities such as Niterói and São Gonçalo. Highlighting the fact that such systems do not connect.

In the metropolitan region of Rio de Janeiro, there is a preponderant concentration in the supply of water to consumers connected to the network by the Guandu and Imuna-Laranjal systems, while those who are not connected and usually not supplied use artesian wells without a permit and applicable legal instruments, especially in the municipalities of Tanguá, with relevant agricultural production, and Maricá, with clear population growth.

When we compare the metropolitan region of Rio de Janeiro to scenarios such as Sertão, not only northeastern regions, we evidence the discrepancy in the water matrix of these scenarios. While in the hinterland at least 5 (five) minimally distinct sources of water are used, exemplifying pluvial (rain), underground, flowing river (fluvial), dam or weir and reuse of gray and/or brown water, in the scenario of Rio de Janeiro there are only 2 (two) underground and flowing rivers that in the occurrence of an accident or analogous element triggers crises such as the recent ones of geosmin, in the Guandu system, and of the toluene, in the Imuna-Laranjal system.

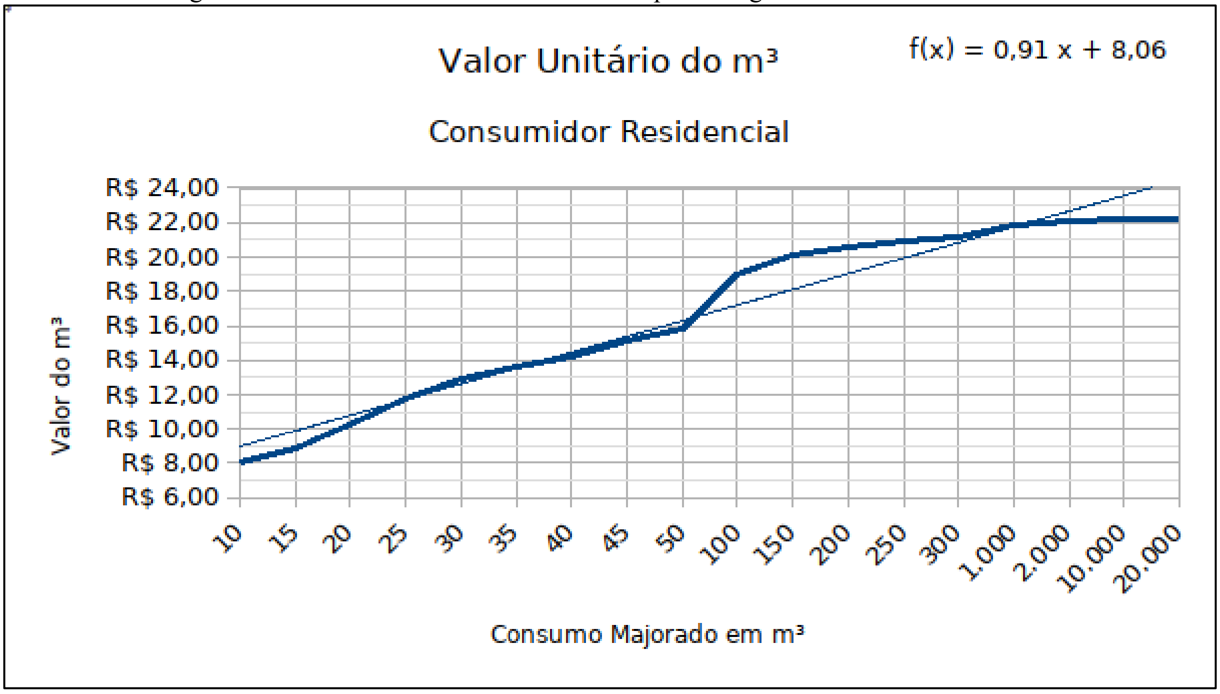
Maricá, theoretically supplied by the Imuna-Laranjal system, has a considerable recent population increase, consequently an increase in the demand for water and as a minimally forced structural element the unavailability of its own sources and water treatment sites. Giving rise to demands for sources of abstraction with emphasis on proposals for desalination and transposition analogous to what occurred with the guandu system, with little emphasis on the regularization of the use of groundwater and the non-potable reuse of rainwater, object of this work.

MATERIAL AND METHOD - ECONOMIC APPLICATION AND BILLING

Sanitation billing follows the logic where those who consume the most pay the most with the unit cost of the water consumed. In terms of values, the more one consumes, the higher the value of the m^3 consumed by the consumer and supplied by the distributor.

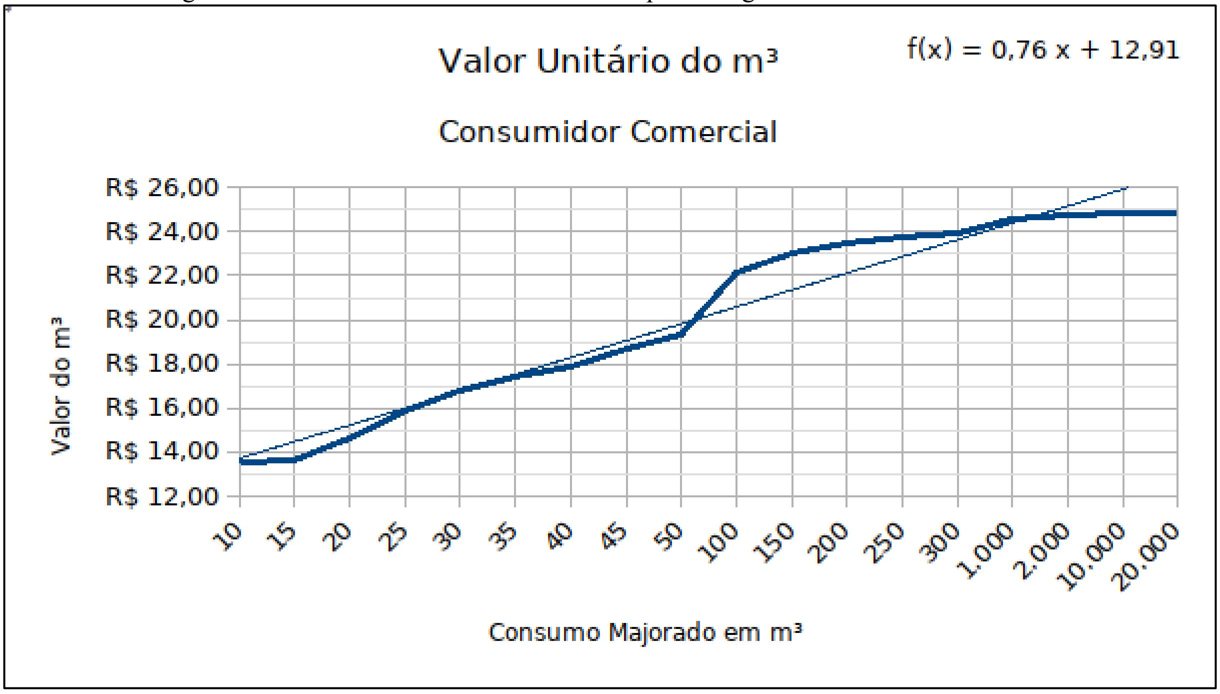
As a demonstration, evidenced the non-availability of the table of costs and billing values in the Rio de Janeiro scenario in the form of ARSAE-MG Resolution No. 173, of November 24, 2022, we have the table of the Sanitation Company of Minas Gerais (Copasa) for the year 2022 with respective unit costs per m^3 (water and sewage) in the residential and commercial consumer classes.

Figure 1: Value of the unit m³ at each consumption range for residential consumers



Source: ARSAE-MG, 2022.

Figure 2: Value of the unit m³ at each consumption range for commercial consumers



Source: ARSAE-MG, 2022.

Objectively, the amount to be paid by the respective consumer is the product of consumption increased in m³ and the value of m³ (unit). From another perspective, we present the billing table for the respective classes below.

Table 1 – Value of the unit m³ in each consumption range for residential consumers

Order	Volume (m³)	Cost (R$)	Unit Value of m³	Increment
1	0	R$ 30,64		
2	5	R$ 46,49	R$ 9,30	
3	10	R$ 80,30	R$ 8,03	86,36%
4	15	R$ 132,70	R$ 8,85	110,17%
5	20	R$ 204,23	R$ 10,21	115,43%
6	25	R$ 295,22	R$ 11,81	115,64%
7	30	R$ 386,20	R$ 12,87	109,02%
8	35	R$ 477,19	R$ 13,63	105,91%
9	40	R$ 568,17	R$ 14,20	104,18%
10	45	R$ 679,17	R$ 15,09	106,25%
11	50	R$ 790,17	R$ 15,80	104,71%
12	100	R$ 1.900,17	R$ 19,00	120,24%
13	150	R$ 3.010,17	R$ 20,07	105,61%
14	200	R$ 4.120,17	R$ 20,60	102,66%
15	250	R$ 5.230,17	R$ 20,92	101,55%
16	300	R$ 6.340,17	R$ 21,13	101,02%
17	1.000	R$ 21.880,17	R$ 21,88	103,53%
18	2.000	R$ 44.080,17	R$ 22,04	100,73%
19	10.000	R$ 221.680,17	R$ 22,17	100,58%
20	20.000	R$ 443.680,17	R$ 22,18	100,07%

Table 2 – Residential consumer billing basis

Residential	Limit	Water	Sewage
Fixed	Fixed	17,61	13,03
0 a 5m³	5	1,82	1,35
>5 a 10m³	5	3,89	2,88
>10 a 15m³	5	6,02	4,46
>15 a 20m³	5	8,22	6,08
>20 a 40m³	20	10,46	7,74
>40m³	1.00E+18	12,76	9,44

Source: ARSAE-MG, 2022.

Table 3 – Value of the unit m³ at each consumption range for commercial consumers

Order	Volume (m³)	Cost (R$)	Unit Value of m³	Increment
1	0	R$ 49,63		
2	5	R$ 83,98	R$ 16,80	
3	10	R$ 135,50	R$ 13,55	80,67%
4	15	R$ 204,81	R$ 13,65	100,77%
5	20	R$ 292,12	R$ 14,61	106,97%
6	25	R$ 397,95	R$ 15,92	108,98%
7	30	R$ 503,77	R$ 16,79	105,49%
8	35	R$ 609,60	R$ 17,42	103,72%
9	40	R$ 715,42	R$ 17,89	102,69%
10	45	R$ 839,88	R$ 18,66	104,35%
11	50	R$ 964,33	R$ 19,29	103,34%
12	100	R$ 2.208,88	R$ 22,09	114,53%
13	150	R$ 3.453,43	R$ 23,02	104,23%
14	200	R$ 4.697,98	R$ 23,49	102,03%
15	250	R$ 5.942,53	R$ 23,77	101,19%
16	300	R$ 7.187,08	R$ 23,96	100,79%
17	1.000	R$ 24.610,78	R$ 24,61	102,73%
18	2.000	R$ 49.501,78	R$ 24,75	100,57%
19	10.000	R$ 248.629,78	R$ 24,86	100,45%
20	20.000	R$ 497.539,78	R$ 24,88	100,06%

Source: ARSAE-MG, 2022.

Table 4 – Commercial consumer billing basis

Residential	Limit	Water	Sewage
Fixed	Fixed	28,52	21,11
0 a 5m³	5	3,95	2,92
>5 a 10m³	5	5,92	4,38
>10 a 15m³	5	7,97	5,9
>15 a 20m³	5	10,04	7,43
>20 a 40m³	20	12,16	9
>40m³	1000000000000	14,31	10,59

Source: ARSAE-MG, 2022.

In view of the facts, the more the consumer unit consumes, the greater the value of the respective m³ consumed, regardless of its class, triggering the conflict of interest regarding the socio-environmental dynamics from the perspective of the consumer and society as a whole, and the significant economic loss (loss of profit) of the sanitation company, since the more water the isolated consumer consumes, the higher the bill in relation to the concessionaire and the lower the availability of water for the other consumers of the system, aggravated by the greater need for the network to the detriment of the concessionaire.

In an applied way, 5 (five) commercial consumer units of 10m³ each have a total bill of R$677.50. 1 (one) 50m³ consumer unit of the same commercial class bills R$964.33 and 7 (seven) 10m³ consumer units have a combined bill of R$948.50. Thus, there is a clear advantage in favor of the concessionaire in the amount of R$286.83 or 42% for the concentration of distribution, triggering a conflict of interest in the concessionaire's revenue, increase in the distribution network and the respective social function of the public service provided.

RAINWATER HARVESTING SYSTEM – APPLICATION OF ECONOMIC RESULT

A hypothetical 1 is presented. average monthly rainfall for a given location (not explained above), with a loss of 20% due to evaporation, infiltration and various losses from the rainwater collection system and 2. assumption of monthly storage of this water for various dimensions of roofs follows.

Table 5 – 1. Hypothetical precipitation and 2. Results in m³ of water abstracted for different cover dimensions

1. Precipitation			2. Roof Assumption m² Result in m³				
Month	Average Rainfall (mm – l/m²)	20%	50m²	100m²	150m²	200m²	1000m²
January	200	160	8m³	16m³	24m³	32m³	160m³
February	220	176	8,8	17,6	26,4	35,2	176
March	210	168	8,4	16,8	25,2	33,6	168
April	160	128	6,4	12,8	19,2	25,6	128
May	100	80	4	8	12	16	80
June	80	64	3,2	6,4	9,6	12,8	64
July	70	56	2,8	5,6	8,4	11,2	56
August	80	64	3,2	6,4	9,6	12,8	64

September	120	96	4,8	9,6	14,4	19,2	96
October	160	128	6,4	12,8	19,2	25,6	128
November	180	144	7,2	14,4	21,6	28,8	144
December	190	152	7,6	15,2	22,8	30,4	152m³

Source: Developed by the author, 2024.

In practical terms: a 50m² roof, in January, with 200mm rainfall and 40mm loss (20%) can take advantage of 8m³ of water from the average monthly rainfall. In a residential property with a 50m² roof, hypothetically 3 people live who consume an average of 120l/day*person who, when applied to 30 days a month, generate a monthly consumption of around 3 people*(120l/day*person)*30days = 10.8m³ monthly = 10m³.

A commercial center type business (mini mall or gallery) that does not process food or equivalent 200m² of roof and with a large preponderance of water for toilet flushing and cleaning of common areas, a monthly volume of 50m³ of water would change its monthly revenue as follows:

Month	Volume Generated by Reuse (50m³ – monthly rainfall)	New Billing for Reuse	Difference for 50m³ consumption
January	18	R$ 257.19	-R$ 707.14
February	14.8	R$ 204.81	-R$ 759.53
March	16.4	R$ 239.73	-R$ 724.60
April	24.4	R$ 397.95	-R$ 566.39
May	34	R$ 588.43	-R$ 375.90
June	37.2	R$ 673.09	-R$ 291.24
July	38.8	R$ 694.26	-R$ 270.08
August	37.2	R$ 673.09	-R$ 291.24
September	30.8	R$ 524.94	-R$ 439.40
October	24.4	R$ 397.95	-R$ 566.39
November	21.2	R$ 334.45	-R$ 629.88
December	19.6	R$ 292.12	-R$ 672.21

According to Copasa's billing costs, 50m³ generates a monthly cost of R$964.33, considering a monthly expense of maintenance of the rainwater system in the amount of R$200, so we have as a gain by the consumer implementing the rainwater harvesting system the annual amount of R$6,293.97 – 12 (months)*R$200 = R$3,893.97 annually.

Disregarding the existing storage system in the facility and applying the availability of area for the installation of the reservoirs, we observed that the maximum volume stored by the system is 35.2m³ per month, which through a reservoir with the following fixed, mobile and modular conditions presents an implementation cost from R$4,000.00 (plastic mesh structure) to the commercially and not extravagant R$36,000.00 (stainless steel system), with respective *payback* from just over 1 (one) year to less than 10 (ten) years and a useful life above 25 years.

RESULTS AND DISCUSSIONS

Let's imagine a commercial building with 10 floors and 8 commercial rooms on each floor, disregarding the ground floor. The referred building has, by arbitration, 80 commercial rooms, where each room, consuming an average of 10m³, would generate an isolated revenue per unit of R$135.50 and R$10,840 for the entire building, and in the joint billing of the building, R$19,632.58 and R$245.40 per unit.

A building like the one described above presents a series of impossibilities in rainwater storage due to the unavailability of land or areas for the installation of reservoirs and rainwater storage structure, bringing a result that is not necessarily good in covering the roof area. However, in a residential condominium of houses there is mitigation of these problems, given the vast roof coverage, availability of land that can be rented and the ease in connection and integration of these systems, such as the installation of photovoltaic systems not the object of this work.

We propose an allotment with 1000 lots, 500 properties built with roofs around 100m² and monthly volume of each property built in 20m³, the annual revenue of each unit would drop from 240m³ per year to about 100m³ in the form of the proposed model that associated with the synergy of the photovoltaic system would generate interesting revenue for the vacant land.

In view of the facts, there is an evident conflict of interest between the State and water distributors with the needs of consumers and the amount paid by them for the billed water. That is why restrictions on the use of rainwater are fostered, generating a certain disincentive and risk for those who will adopt measures for its development in the form of sanctions.

CONCLUSION

There are regulations, in the Rio de Janeiro scenario, that hinder and generate risk to the development of a rainwater harvesting system in buildings, typified in the form of article 3 of Fluminense Law No. 9,164 of December 28, 2020. On the other hand, there is consumer demand, occurrence of claims, concentration of water sources and matrix, and a certain discontent associated with the dissemination of information through social media.

The economic advantages in favor of the consumer do not favor individual measurement and the development of systems for the use and use of rainwater, since it is evidenced by the significant loss of revenue by the distributors and of power resulting from this revenue by themselves and by the State, in a manner analogous to what has been occurring in the electric system.

Thus returning to the conflict of interest between the consumer claimant and the one who controls and distributes, aggravated by the perception that the service provided is at least insufficient and the growing demand with increased scarcity due to the non-adoption of measures to conserve water sources such as sewage treatment.

The only apparent certainty is the increase in pain for the consumer, either due to scarcity, followed by the unavailability of water and consequent increase in cost, or by the distributors and the State due to the increase in fraud, default and use of means to meet the minimum living conditions and consequently water supply.

In the telecommunications scenario, this type of conflict for new media is constant, as in the case of *WhatsApp* vs. messaging and calling service by telecommunications companies, in which the inadequacy by telecommunications companies triggers their suppression and decrease, as occurred in the scenario of wired networks.

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