Fostering water resilience in rural communities: Providing safe water in the Paraopeba basin using decentralized solutions

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Highlights:

- Improving water resilience in rural areas through an implemented project of decentralized water treatment systems in the Paraopeba basin.
- Main challenges of this project are logistical difficulties due to geographical dispersion, groundwater quality, and infrastructure of the sources served.
- The technologies selected in the scope of the project are succeeding in adapting the water consumed at the sources served.

Keywords: Decentralized rural sanitation; groundwater; water quality.

INTRODUCTION

In Brazil, there is great inequality in access to water and sewage services, which has yet to be effectively addressed. While around 90 % of the urban population has access to piped water, 67.2 % of the rural population collects water from sources considered to be unsafe (Funasa, 2011). In the Southeast, groundwater and spring water collection is the most widely adopted solution when there is no piped water supply (Funasa, 2019). Given the vulnerability of the rural population to water supply - whether due to the lack of a legal framework and institutional representation, plurality, or geographical distribution, this paper aims to present an implemented project of decentralized water treatment systems to serve the rural population living in the Paraopeba river basin in Minas Gerais. The project was conceived in partnership with the Minas Gerais State Health Department (SES-MG) following the collapse of the B1 dam in Brumadinho in 2019. The study aims to show the challenges and potential of setting up decentralized water supply systems in the country and to contribute to national knowledge on the subject.

METHODOLOGY

Installing decentralized treatment systems to serve single-family homes and rural communities aims to improve the quality of the water consumed by the population from pre-existing underground sources. The project serves 152 locations in 22 municipalities: Betim, Brumadinho, Caetanópolis, Curvelo, Esmeraldas, Felixlândia, Florestal, Fortuna de Minas, Juatuba, Maravilhas, Mário Campos, Morada

Nova de Minas, Papagaios, Pará de Minas, Paraopeba, and Três Marias. The physical, geographical, and hydrogeological characteristics of the locations in question were considered, such as access, availability of land, and electricity, the infrastructure needed to collect water from the sources, and the hydrochemical composition of the groundwater. Socio-economic factors were also considered, such as the heterogeneity of the population in the territory in terms of social and cultural dynamics, education, and income. The aspects discussed showed the obvious need for the systems implemented to have low operational complexity, simplicity, and low maintenance costs, as well as the technical capacity to produce water within drinking water standards. The treatment configurations were selected considering the following stages, combined depending on the characteristics of each location: disinfection; pH adjustment; zeolite and/or activated carbon filters; pre-oxidation tank; and softeners. The complementary infrastructure consisted of prefabricated plate covers to protect the treatment units and peripheral equipment.

Along with the implementation stages, a Communication Plan was drawn up for the project, with ongoing and interrelated communication and social mobilization strategies to engage users with the water treatment systems implemented. The social mobilization strategies consist of periodic face-to-face visits by social mobilization teams, to build a relationship of trust with landowners and community leaders. In addition, visits are made by technical professionals trained in social dialogue engagement to diagnose the underground water sources, as well as to monitor and verify the progress of the installations and the integrity and functionality of the components of the water treatment systems. In addition, a Call Center was set up for landowners to make requests, manifestations, and complaints related to the project.

RESULTS AND CONCLUSIONS

Table 1 shows the descriptive statistics of the main contaminants found in the raw water from the underground sources selected for the installation of the water treatment systems. Bacteriological parameters were also assessed, for which violations were found in 93 % of the underground sources. For all the systems in operation, the treatment routes chosen proved to be effective, and monitoring of the points indicates that the quality of the treated water is suitable for human consumption, with the parameters complying with the maximum values permitted by the national law, GM/MS Ordinance No. 888/2021. The main contaminants removed by the treatment include total aluminum, apparent color, total iron, total manganese, total coliforms, E. coli, turbidity, and total zinc.

Table 1 - Main contaminants found in raw water from sources to be treated.

Parameter	Unit	Minimum	Quartile 25	Mean	Median	Quartile 75	Maximum
Aluminium Total	µg/L	1.00	1.37	181.72	20.00	135.00	177,000.00
Arsenic Total	µg/L	0.50	1.00	1.48	1.00	1.00	57.00
Barium Total	µg/L	1.00	11.90	58.41	29.70	70.10	2,230.00
Lead Total	µg/L	0.50	1.00	5.66	2.26	10.00	1,890.00
Colour	CU	5.00	5.00	24.84	10.00	15.00	5,000.00
Iron Total	µg/L	1.00	35.25	1,376.23	100.00	908.75	95,600.00

Parameter	Unit	Minimum	Quartile 25	Mean	Median	Quartile 75	Maximum
Manganese Total	µg/L	1.00	4.35	81.71	20.00	71.10	11,400.00
Turbidity	NTU	0.10	0.39	16.31	1.83	12.98	6,050.00
Zinc Total	µg/L	1.00	5.40	276.84	20.00	104.50	37,600.00

The positive aspects of these systems implemented (Figure 1) include the lack of need for major infrastructure works and increased regional water resilience since several sources are used for supply. Even taking these fundamental precepts as a basis for selecting the technologies used in this project, there are still minimum infrastructure requirements that sometimes present a challenge in the countryside. In any case, it should be emphasized that even with all the challenges, the solutions implemented and in operation can deliver drinking water to the places served continuously, thus contributing to improving access to water in these locations.

Sanitation actions in rural environments need an approach that goes beyond the technicality of water treatment itself and considers the relationship between water sources, the resource itself, and its users. For this reason, as important as the technical aspects, it is also necessary to develop ownership strategies for the treatment systems implemented. Thus, in addition to implementing the technologies themselves, 67 manuals and databooks have been delivered, 201 humanized reports have been delivered and around 800 field visits have been made. This has made it possible to strengthen ties with the communities, understand their concerns, and share visions and knowledge of the reality that surrounds them, as well as provide information and clarify doubts about the project.

Figure 1 – Treatment system implemented, comprising (a) cover and (b) water filtration unit

(a) 

(b) 

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