



(RESEARCH ARTICLE)



HOUSEHOLD PRACTICES AND PERCEPTIONS OF BOREHOLE WATER IN LAMBANYI MUNICIPALITY GUINEA

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ABSTRACT

Domestic boreholes are essential for self-supply in cities with inadequate public water services. This study examines household practices and perceptions of borehole water in Lambanyi, Conakry, Guinea. A descriptive cross-sectional survey covered 383 households in four neighbourhoods from 5 to 25 June 2024. Data collected through a Microsoft Forms questionnaire were processed in Microsoft Excel using descriptive statistics and thematic analysis of open-ended responses. Overall, 305 households (79.6%) reported boreholes as their sole water source, and 360 (94.0%) used them alone or alongside another source. Only 126 households (32.9%) owned a borehole within their compound; 124 of these (98.4%) also had a storage tank. Across the sample, 202 households (52.7%) reported storage facilities. Although 326 households (85.1%) reported no availability or quality problems, 82 (21.4%) reported access difficulties or conflicts. Stomach pain was reported by 52 households (13.6%) and diarrhoea by 25 (6.5%), without clinical confirmation or evidence that borehole water caused these symptoms. Boreholes play a central role in water supply, but their use extends beyond ownership and raises concerns about access and sanitary oversight. Findings are limited to self-reported information from four neighbourhoods. Strengthening the public network, coordinating borehole management and informing households about safe storage and water quality are priorities for local water management.

Keywords: Domestic borehole; Household practices; Community perceptions; Water access; Lambanyi

1 INTRODUCTION

Groundwater is the main source of water for most households in the study area because the public distribution network is inadequate. Understanding local community perceptions is essential to analysing the social and environmental effects of domestic boreholes. Research on community perceptions examines awareness of groundwater quality, availability and abstraction risks, as well as difficulties in accessing water [1–3]. It also highlights inequalities in access, potential conflicts, health concerns and community expectations for sustainable water management. We therefore surveyed households in Lambanyi municipality to document residents' views and their use of domestic boreholes in relation to these issues.

In sub-Saharan Africa, many urban public water networks are inadequate or poorly developed, requiring residents to diversify their water sources. Domestic boreholes provide direct access to groundwater and form an important part of urban self-supply. Their effects remain difficult to assess, however, when private abstraction points are poorly registered and users' practices are insufficiently documented [4,5].

In Conakry, groundwater has supplemented the collective water network for several decades. A study examined well-water quality in two parts of the city and compared it with distributed water [6]. Research in Ratoma also examined the effects of the proliferation of urban boreholes [7]. These studies place practices in Lambanyi within an urban context where daily access to water depends partly on private arrangements.

The presence of a borehole does not, however, reveal households' actual conditions of access. Availability may depend on ownership, electricity, storage and neighbourhood arrangements, while water considered satisfactory by users may not have undergone sanitary checks. Self-supply therefore needs to be assessed in terms of accessibility, quality and management responsibilities [8,9].

The research question in Lambanyi is how households obtain and use borehole water, and how they understand the associated difficulties and risks. The objective is to analyse household use of borehole water in the municipality. Specifically, the study describes water sources, ownership of facilities, storage, reported uses, access difficulties and community expectations. It also examines reported symptoms and disadvantages in terms of perceptions and the available evidence.

2 MATERIALS AND METHODS

2.1 Sample selection

The study concerns households in Lambanyi municipality. We used probability sampling to select four of the municipality's eleven neighbourhoods by a random draw without replacement [10]. Every neighbourhood therefore had a chance of being selected, although only four were studied. The household sampling frame, the selection procedure within each neighbourhood, and the handling of refusals and replacements also require documentation. We then surveyed the study population about its perceptions of borehole water. The target population primarily comprised municipal officials, neighbourhood leaders, and household heads or their representatives aged at least 18 years. Following the division of Ratoma municipality into three other municipalities in 2024 [11], Lambanyi comprises eleven neighbourhoods, with an average of 18,132 inhabitants per neighbourhood. Its socioeconomic conditions fall into three levels: high, middle and low. A sampling approach covering all social groups is therefore necessary.

2.2 Sample composition

The sample was designed for a survey of water supply, use and storage, together with household perceptions in Lambanyi. The protocol draws on Cochran (1977). The sample examined consists of 383 households across four neighbourhoods. The following steps distinguish the information presented in the manuscript from procedures that require supporting field records.

2.2.1 Sampling frame and random selection

The manuscript describes a random draw without replacement of four of the municipality's eleven neighbourhoods. The first-stage sampling frame must therefore contain a complete list of the eleven neighbourhoods, dated and validated for the data collection period. The procedure consists of placing eleven identical slips bearing neighbourhood names in a container and drawing four slips without returning them. The selected neighbourhoods were Simbaya Gare, Nongo Tady, Wanindara Rails and Bantounka 2. A claim that all neighbourhoods were drawn and retained would be incorrect, as the list contains only four selected neighbourhoods.

Under this equal-probability draw, each neighbourhood has a selection probability of 4/11, or 36.36%. If households were then randomly selected within the chosen neighbourhoods, this would be a two-stage design, with neighbourhoods selected first and households second. This distinction is necessary when analysing data within their geographical sampling framework [12]. Selecting four neighbourhoods alone does not constitute stratified sampling by socioeconomic status.

2.2.2 Sample size justification

The total sample size was calculated using Cochran's (1977) formula, with a 95% confidence level, a 5% margin of error and an expected proportion of 0.50. After correction for the finite population size, 383 households were retained. This sample was allocated to the four selected neighbourhoods in proportion to their household populations, using the following relationship:

$$n_h = n \frac{N_h}{N_s}$$

Here, n_h is the number of households to be surveyed in neighbourhood h , N_h is the total number of households in that neighbourhood, n is the total sample size, and N_s is the total number of households in the four selected neighbourhoods. Proportional allocation is therefore a step in distributing the sample, rather than a separate sampling method.

For this sampling approach, we set a 95% confidence level ($t = 1.96$) and a 5% margin of error [13]. The sample size was therefore calculated using the following formula:

The final sample comprised 383 households. The respondent was the household head or, when absent, an adult household member aged at least 18 years who was sufficiently familiar with water supply, use and storage practices. Where several adults met these conditions, one respondent was selected at random. Municipal officials and neighbourhood leaders interviewed in their institutional capacity were not part of the 383-household sample, and their interviews were to be analysed separately.

After allocation and rounding, 383 households were surveyed: 96 in Simbaya Gare, 94 in Nongo Tady, 96 in Wanindara Rails and 97 in Bantounka 2. In each neighbourhood, households were randomly selected from the numbered sampling frame. If a household refused, remained absent after two visits at different times, or could not respond, the interviewer did not freely choose a replacement. The case was recorded as non-response and, when replacement was necessary to reach the planned sample size, the next household was selected from a reserve list generated by the same random procedure. The response rate was calculated for each neighbourhood.

For estimates covering the four study neighbourhoods, each household's sampling weight was the inverse of its overall inclusion probability:

$$W_{hi} = \frac{1}{\frac{4}{11} * \frac{n_h}{N_h}}$$

This weight could then be adjusted for the neighbourhood's response rate. When proportional allocation was strictly followed, weights were approximately constant, so unweighted descriptive results remained close to weighted estimates. Any generalisation to the municipality as a whole nevertheless needed to account for the selection of only four primary sampling units and the design effect. The survey aimed to document water sources, uses, perceptions of water quality and reported health problems, without treating these reports as an epidemiological diagnosis [9,14].

2.3 Data collection tools

Questionnaire surveys are used to collect quantitative information on household perceptions of borehole water [15]. We used Microsoft Forms (Microsoft 365) to collect household data. Surveys were conducted in the four neighbourhoods from 5 to 25 June 2024. A three-person team was assembled for 20 days of survey work, with twenty interviews per day.

The questionnaire covered the following topics:

- General information, including locality, respondents' residential status, activities in the area and borehole characteristics;
- Stakeholders' perceptions of boreholes and water access, including information on drinking water and local boreholes;
- Borehole characteristics, including depth, the drilling company, the presence of storage tanks and tank capacity;

- Residents' use of boreholes and operating arrangements in the area;
- Access to water, tank filling and water levels, together with information on water quality and waterborne diseases;
- Perceived disadvantages, to identify problems and challenges associated with boreholes;
- Borehole characteristics, water-related conflicts, local expectations and suggestions for improvement.

2.4 Questionnaire pretest

Before the survey began, the questionnaire was tested on a pilot sample of 20 respondents, approximately 5% of the total sample size.

This step allowed us to:

- Assess whether questions were understood;
- Identify ambiguities;
- Examine the questionnaire's consistency;
- Check the average administration time.

The pretest allowed us to adjust the questionnaire and improve consistency between its sections, particularly in relation to:

- Perceptions of water quality;
- The question about obtaining authorisation, which proved to be an obstacle for respondents.

2.5 Ethical considerations

Participants were informed of the research objectives before their interviews began. The following principles were observed:

- Free and informed consent;
- Respondent anonymity;
- Confidentiality of the information collected;
- Use of the data solely for scientific purposes.

2.6 Data processing and analysis

- The data collected were exported to Microsoft Excel for analysis.
- Descriptive analysis covered frequencies, percentages and means.
- Comparative analysis used cross-tabulations to examine relationships between:
 - Household type and access to water;
 - Borehole depth and water availability.

Quantitative analysis: interviews underwent thematic analysis focused on:

- Perceptions of quality;
- Perceptions of availability;
- Health risks;
- Conflicts over use;
- Residents' expectations.

This approach highlighted spatial differences in groundwater access and perceptions among residents of Lambanyi municipality.

3 RESULTS

This section presents the results of the survey of 383 households in four neighbourhoods of Lambanyi municipality: Simbaya Gare, Bantounka 2, Nongo Taadi and Wanindara Rails. It describes water supply arrangements, respondents' geographical distribution, domestic borehole characteristics, storage facilities, water uses, reported difficulties, conflicts, health problems, perceived disadvantages and household suggestions.

The presentation draws on the counts and percentages available in the survey file. Percentages are treated as descriptive observations, rather than causal evidence at this stage. Where a category total differs from the overall sample size, this is acknowledged for transparency.

3.1 Main sources of household drinking water

Of the 383 households, 305 (79.6%) use borehole water as their main source of supply. This arrangement accounts for approximately four households in five and is the most frequently reported in the sample. Combined sources are less common: 33 households (8.6%) combine borehole and well water, while 21 (5.5%) combine borehole water with the Société des Eaux de Guinée (SEG) network. Only one household (0.3%) reports using boreholes, the SEG network and wells together.

In addition, 19 households (5.0%) rely exclusively on a well, and four (1.0%) report sachet water as their main source. Almost all surveyed households, 360 (94.0%), use boreholes either alone or alongside another water source.

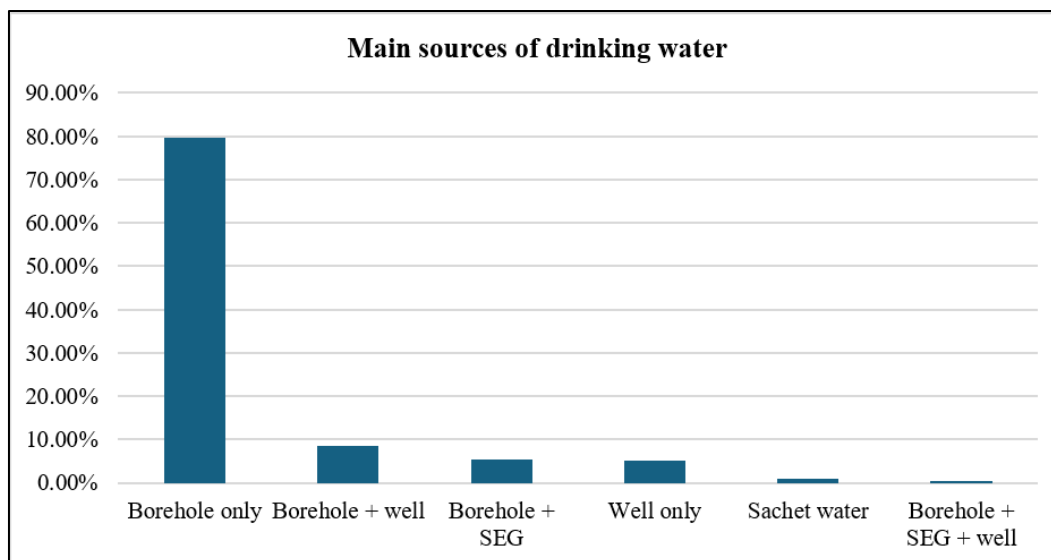


Figure 1: Main sources of household drinking water

3.2 Distribution of surveyed households by locality

The 383 households are distributed fairly evenly across the four study neighbourhoods. Simbaya Gare accounts for 96 households (25.6%), Bantouka for 97 (25.3%), Nongo Taadi for 94 (24.5%), and Wanindara Rails for 94 (25.6%) of the total. The difference between the most and least represented localities is only four households, or approximately one percentage point. This distribution provides comparable numbers for presenting observations from the four neighbourhoods. In terms of respondents' connection to the neighbourhood, 218 (56.9%) are permanent residents, 128 (33.4%) are temporary residents, and 37 (9.7%) are workers or traders. More than half of the responses therefore come from people permanently established in their neighbourhood.

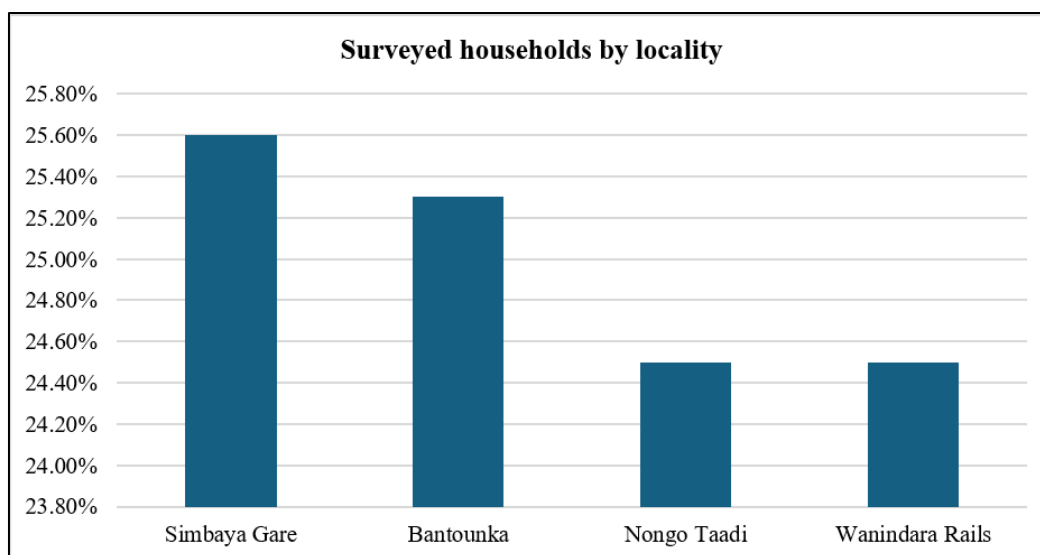


Figure 2: Distribution of surveyed households by locality

3.3 Household borehole ownership

Boreholes are widespread across the four surveyed neighbourhoods. Among the 383 households, 126 (32.9%) own a borehole within their compound, while 257 (67.1%) do not own a private borehole.

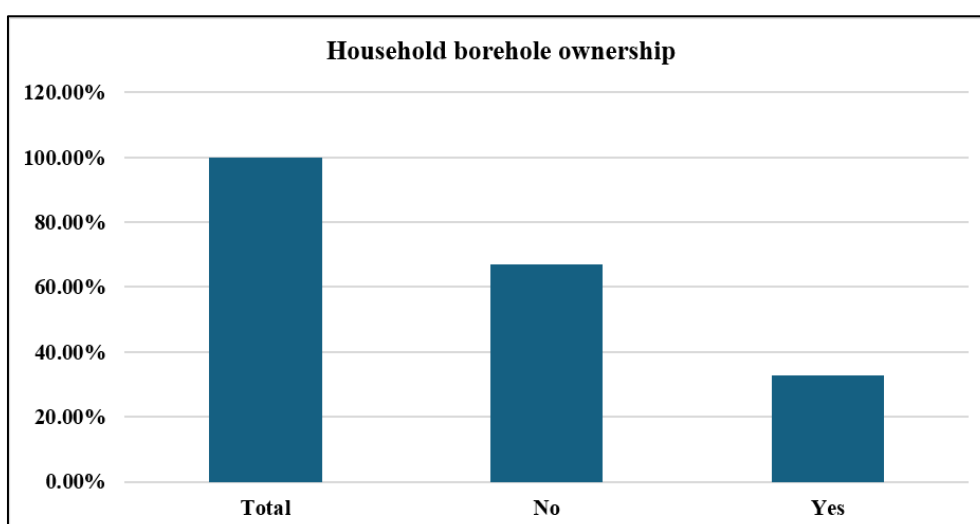


Figure 3: Distribution of households by borehole ownership

3.4 Storage tank ownership among borehole owners

Of the 126 households with a borehole, 124 (98.4%) also have a water storage tank. Only two households (1.6%) have a borehole without a tank.

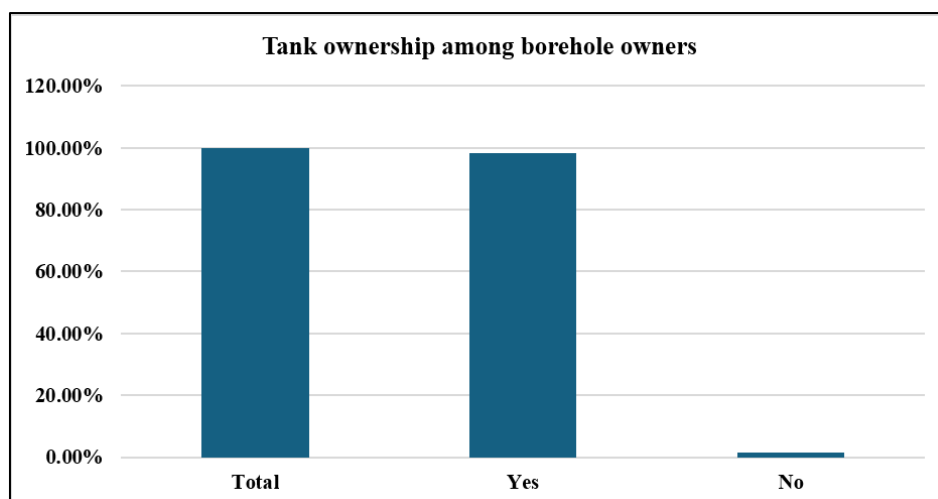


Figure 4: Storage tank ownership among households with a borehole

These results show that borehole ownership is almost always accompanied by a storage tank, with an overall association of 98.4%. Having both facilities allows households to store pumped water for domestic needs when the borehole is not operating.

3.5 Borehole depths

Borehole depth is unknown to 38 respondents, or 30.16% of respondents. This represents more than a quarter of abstraction-point owners. Among reported depths, the 70–89 m class is most common, with 42 boreholes (10.97% of the total). It is followed by depths below 50 m, reported by 23 households (6.01%), and depths above 90 m, reported by 15 (3.92%). The least common class is 50–69 m, with eight boreholes (2.09%). Usable depth information is available for 88 boreholes, or 69.84% of households. Of these 88 reported depths, 57 boreholes reach at least 70 m, equivalent to 64.8% of known depths.

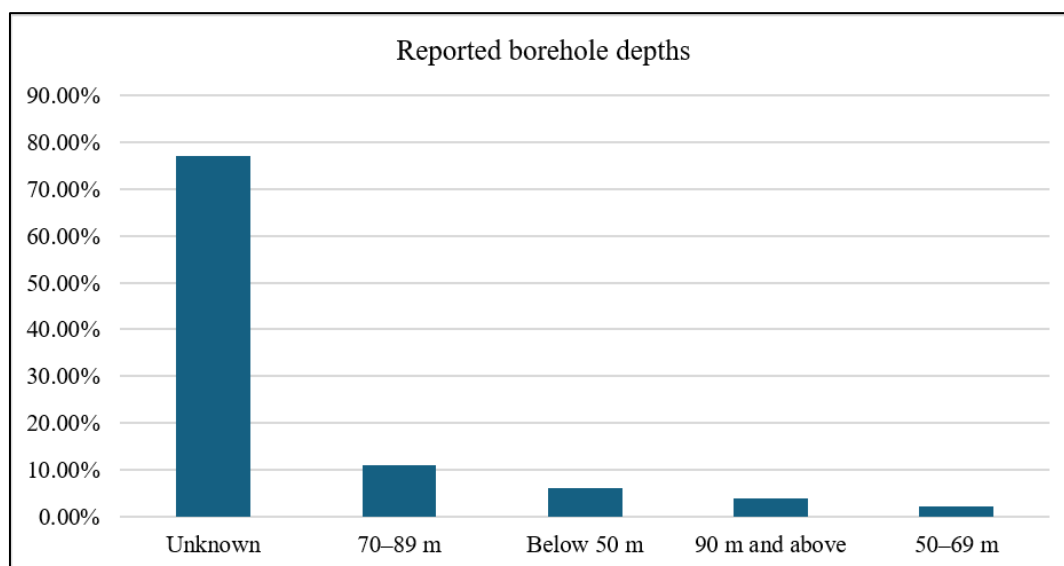


Figure 5: Reported borehole depths

3.6 Drilling companies

Most households do not know which company drilled their borehole: 73 responses, or 57.93%. Identified companies or operators therefore account for only 53 households, or 42.06% of responses (Figure 6).

An unnamed Indian company is the most frequently reported operator, with 16 mentions (4.18%). Bâti Val Guinée is mentioned six times (1.57%), Forage pour Tous five times (1.31%), and EGEFCO SARL and Guinée Forage four times each (1.04%). SRM Forage SARL and SRI Forage each receive three mentions (0.78%).

MATCO SARL, SV Forage and Al Madina Forage are each mentioned by two households (0.52%). Guinean operators, Guinéenne, MATCH SARL, AQUATECH Forage and AQUARECH Forage each appear once (0.26%).

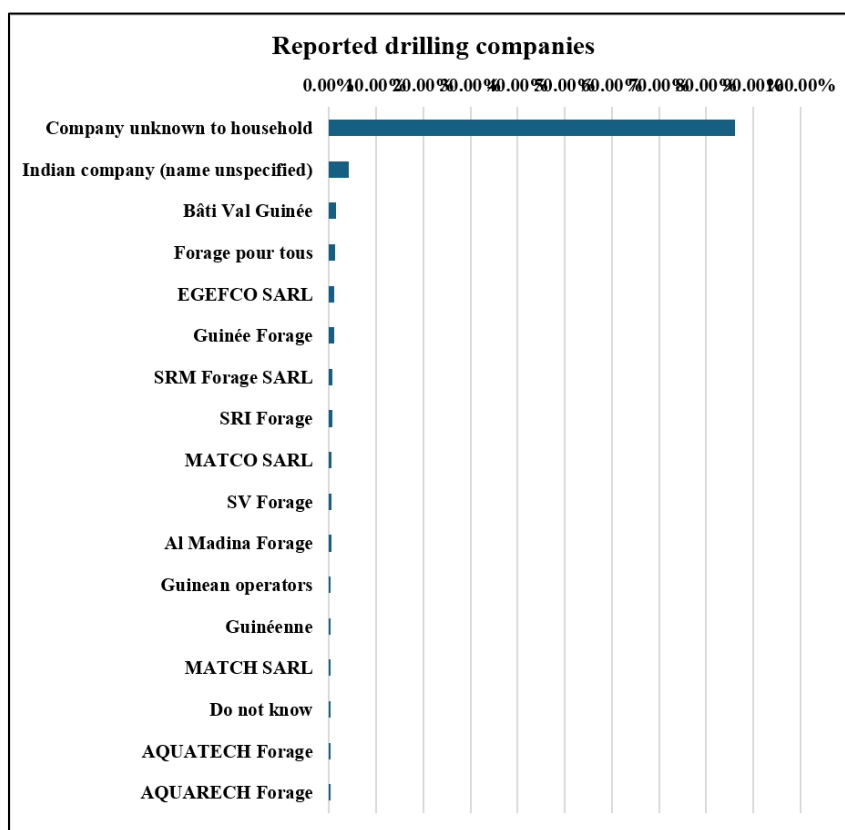


Figure 6: Reported drilling companies

3.7 Boreholes in the immediate neighbourhood

Regarding nearby boreholes, 101 households (26.37%) report three around their compound, the most frequent response. By contrast, 96 households (25.07%) report none nearby. Two boreholes are reported by 84 households (21.93%), one by 55 (14.36%), and four by 39 (10.18%). Cases with five or more are uncommon: five households mention five boreholes (1.31%), one reports six (0.26%), and two report seven (0.52%).

Combining these categories, 287 households (74.93% of the total sample) report at least one borehole in their immediate neighbourhood, and 148 (38.64%) report at least three nearby.

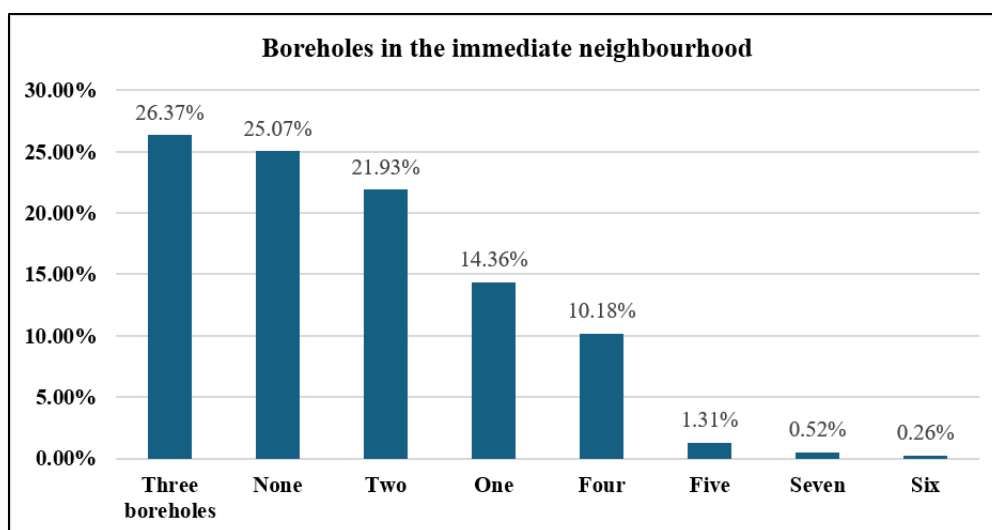


Figure 7: Number of boreholes in the immediate neighbourhood

3.8 State-built boreholes in the study area

Overall, 323 households (84.3%) state that no borehole has been built by the State in their neighbourhood. Forty-six (12.0%) do not know whether such a facility exists, and only 14 (3.7%) report awareness of a State-built borehole. Negative responses are more than 23 times as frequent as positive responses. Facilities resulting from public intervention therefore represent a very small share of the boreholes known to surveyed households (Figure 8).

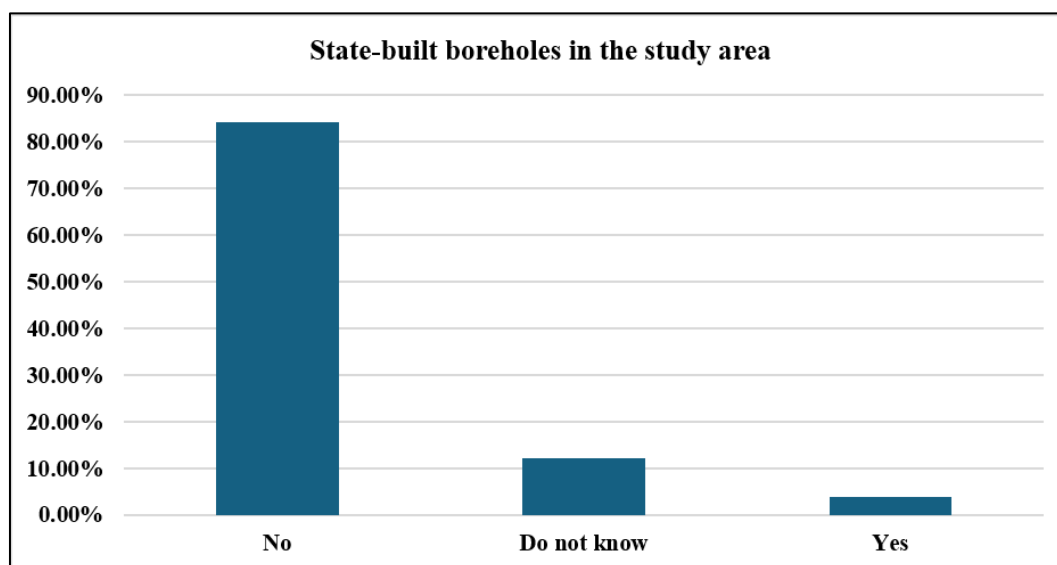


Figure 8: Reported presence of State-built boreholes in the study area

3.9 Daily borehole operating time

Figure 9 presents daily borehole operating times. The analysis covers only the 126 households that reported borehole ownership during the survey. Of these, 115 (91.3%) provided usable information on daily operating time. Operating times for the remaining eleven boreholes were unspecified or unidentified.

The most frequently reported operating time is four hours per day, for 48 boreholes (38.1% of all household boreholes recorded). This is followed by six hours per day for 20 boreholes (15.9%) and three hours per day for 16 (12.7%).

In addition, eight boreholes (6.3%) operate for five hours per day and six (4.8%) for two hours. Five boreholes (4.0%) operate for five to six hours. Operating times of three to four hours and four to six hours each concern three boreholes (2.4%). The least frequent times are 30 minutes, two to three hours, six to seven hours, eight hours and eleven hours; each concerns one borehole (0.8%). One household reports that its borehole operates throughout the day.

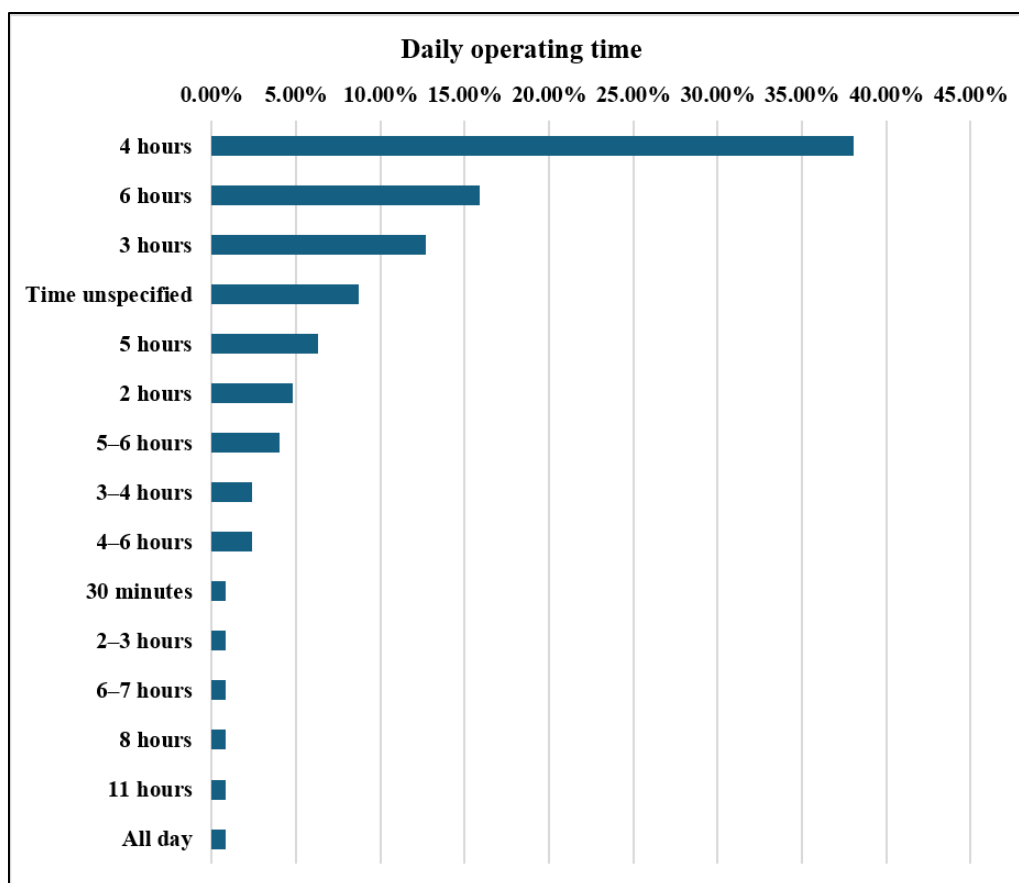


Figure 9: Daily borehole operating time

3.10 Storage tank capacities

Reported tank capacities account for 202 observations. A capacity of 3,000 litres is most common, with 118 cases (58.4% of reported capacities). Tanks of 5,000 litres rank second, with 60 cases (29.7%). A capacity of 2,000 litres is reported by 22 households (10.9%), while 4,000-litre tanks are mentioned only twice (1.0%). Capacities range from 2,000 to 5,000 litres, and 88.2% of responses concern the 3,000- and 5,000-litre categories (Figure 10).

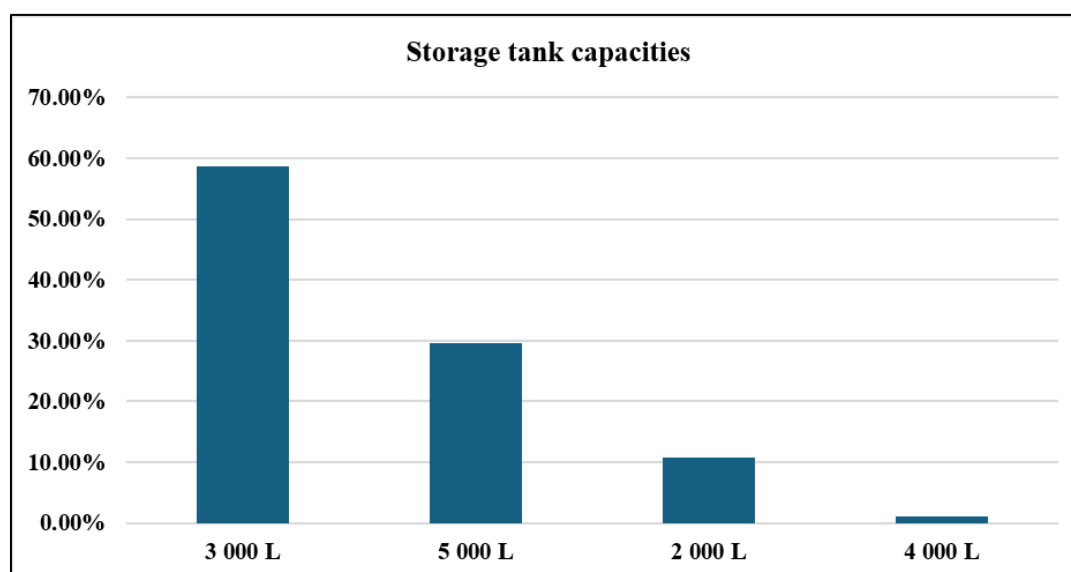


Figure 10: Storage tank capacities

3.11 Tank filling times

Figure 11 presents tank filling times. Of the 383 surveyed households, 202 (52.7%) report having a tank. The most common filling time is one hour, reported by 82 respondents (40.6% of tank-owning households). This is followed by two hours, reported by 54 households (26.7%), and one and a half hours, reported by 27 (13.4%). Three households (1.5%) fill their tank in less than one hour. Five households (2.5%) report three hours, while one (0.5%) reports five hours. Overall, 166 households (82.2%) fill their tank within one to two hours, the most common interval in the study area. However, seven households (3.5%) do not know how long their tank takes to fill, and 18 (8.9%) provide no response. Usable filling-time information was therefore obtained for 172 tank-owning households (87.6%).

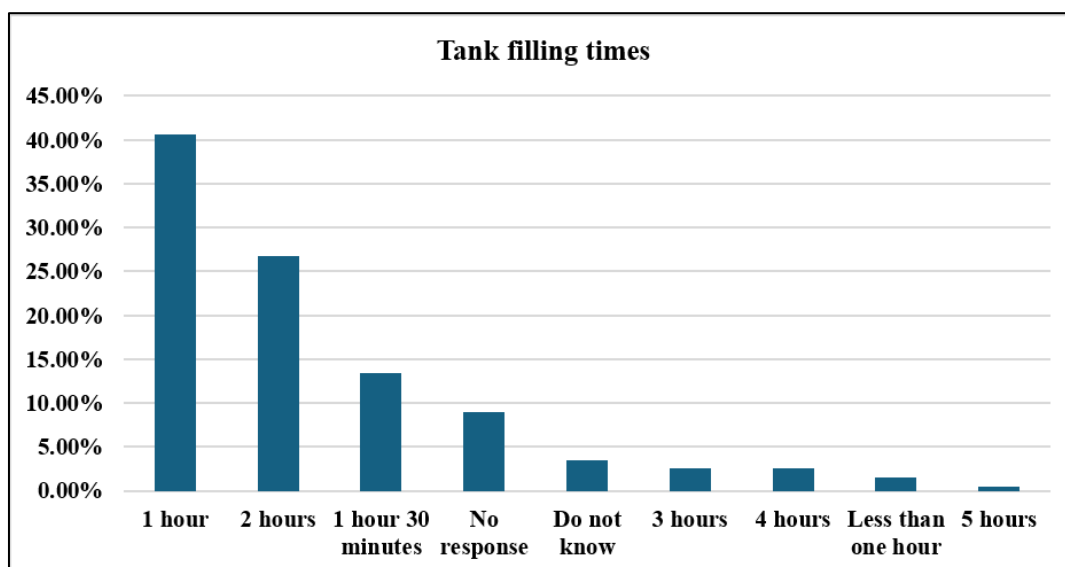


Figure 11: Storage tank filling times

3.12 Uses of borehole water

Household uses are reported by 258 respondents (67.4%). Sixty households (15.7%) use borehole water for all their needs, and 59 (15.4%) use it mainly for drinking. Cooking is reported as a specific use by six households (1.5%). The four categories total 383 responses. Percentages total 100% after rounding to one decimal place.

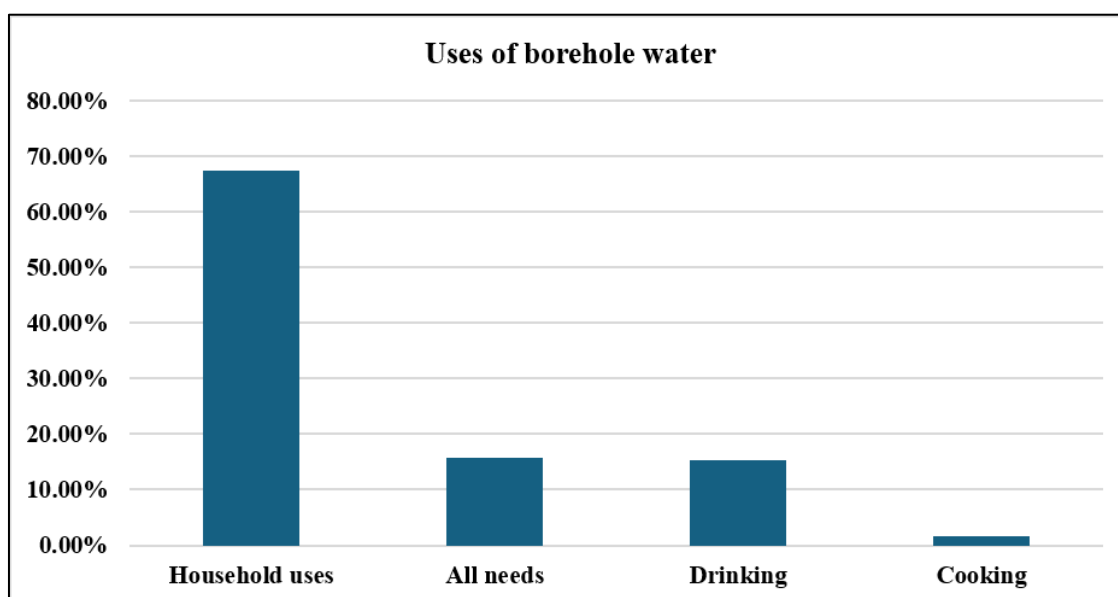


Figure 12: Reported uses of borehole water

3.13 Water availability or quality problems

Most households, 326 respondents (85.12%), report no problem with borehole water availability or quality. Thirteen (3.4%) cannot assess the situation, and 24 responses (6.28%) concern unavailability or a shortage of water. Twenty responses specifically mention cloudy water (5.2% of the total sample).

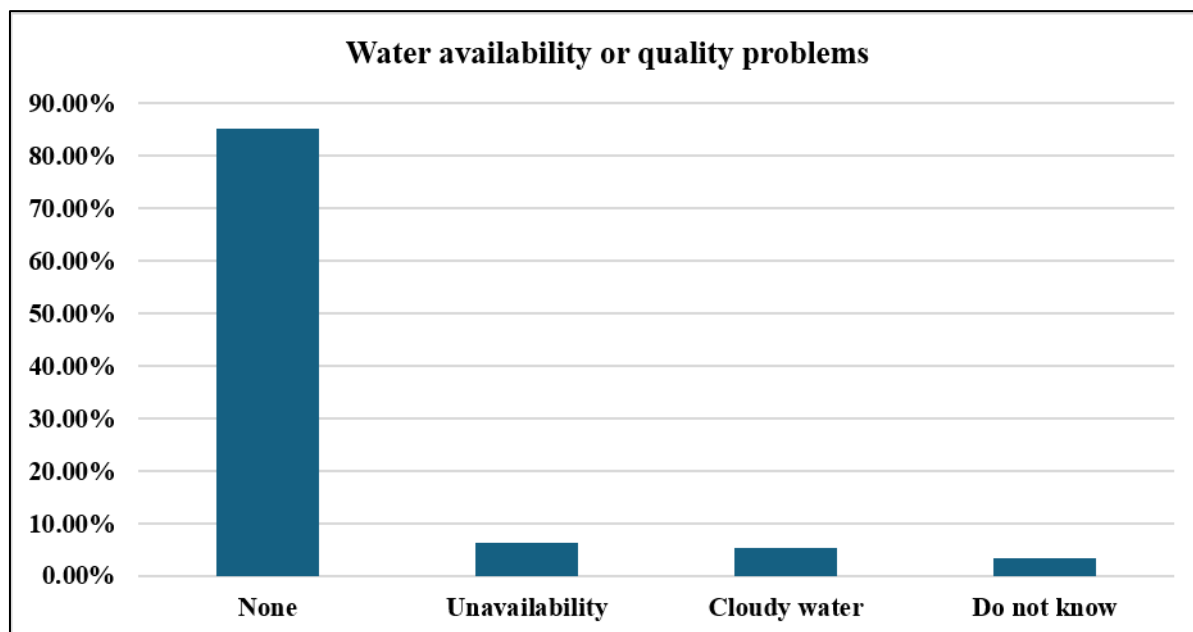


Figure 13: Reported water availability or quality problems

3.14 Conflicts over access to water

No conflict over access to borehole water is reported by 301 households (78.6%). However, 49 (12.8%) report difficult access or refusal to share water, while 33 (8.6%) report disputes or neighbourhood tensions.

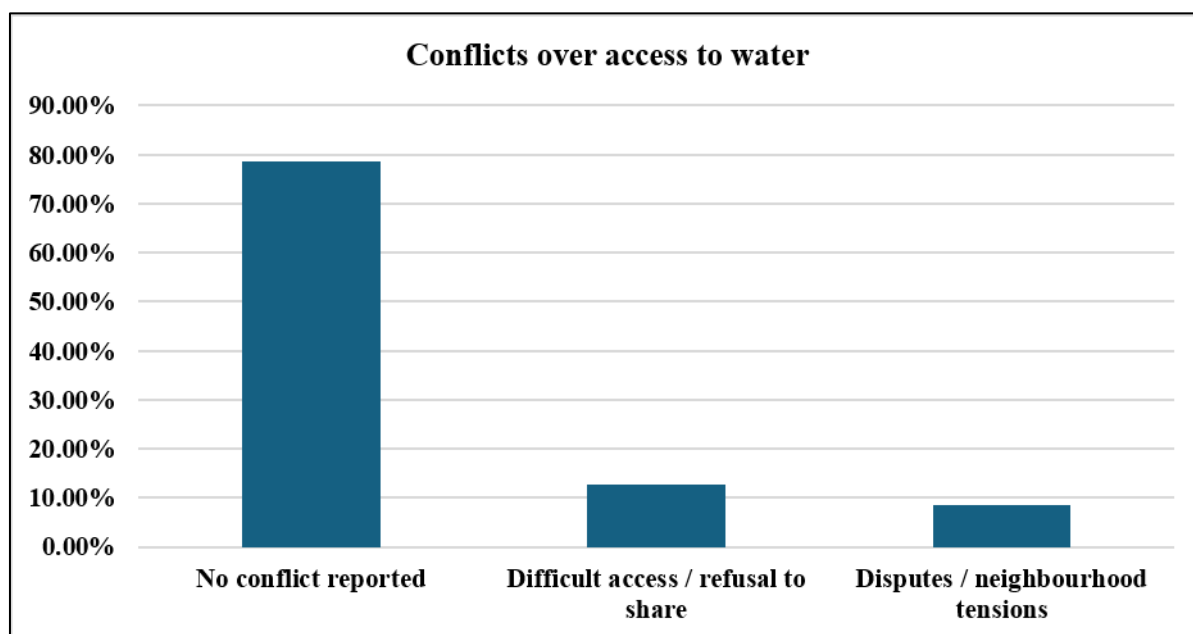


Figure 14: Conflicts over access to water

3.15 Reported illnesses associated with borehole water

Overall, 306 households (79.9%) report no illness associated with borehole water. Stomach pain is reported by 52 households (13.6% of the sample), and diarrhoea by 25 (6.5%). These findings describe symptoms reported by

households. They do not, in themselves, constitute medical confirmation or evidence that borehole water caused the symptoms.

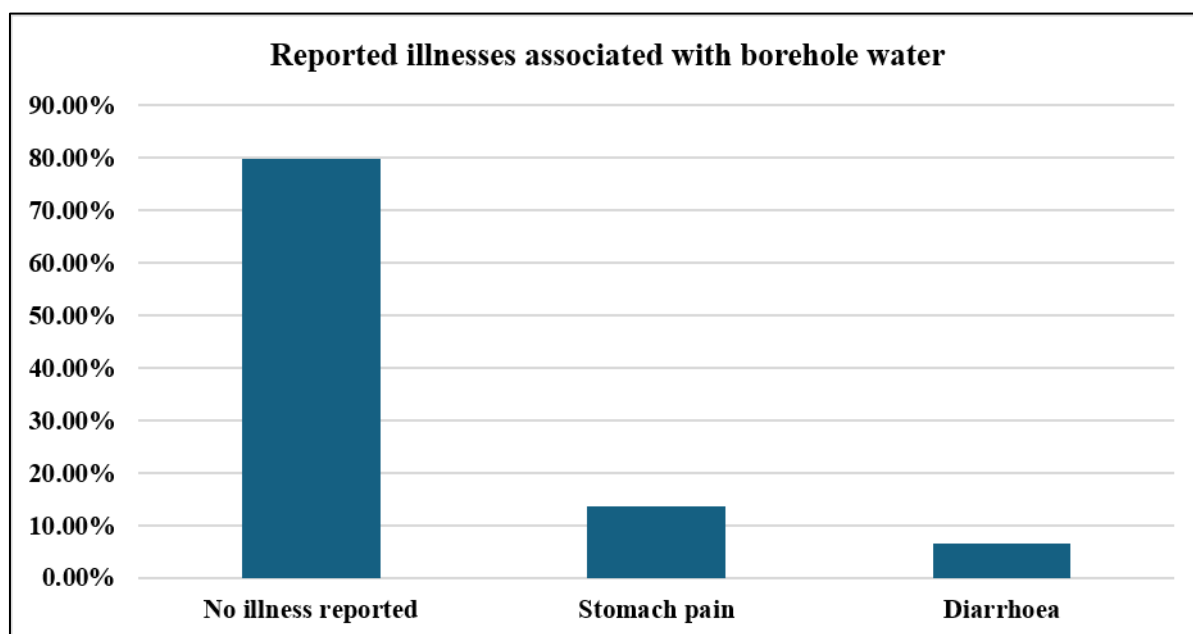


Figure 15: Reported illnesses associated with borehole water

3.16 Disadvantages associated with domestic boreholes

Most households, 307 (80.2%), report no disadvantage associated with domestic boreholes. Seventy-six households (19.8%) report at least one disadvantage among the listed categories.

Among the 76 households reporting a disadvantage, cracks or fractures are most common, with 30 cases (7.8%). They are followed by health and contamination risks, reported by 19 households (5.0%), and landslides, reported by 18 (4.7%). A declining water table is reported by nine households (2.3%).

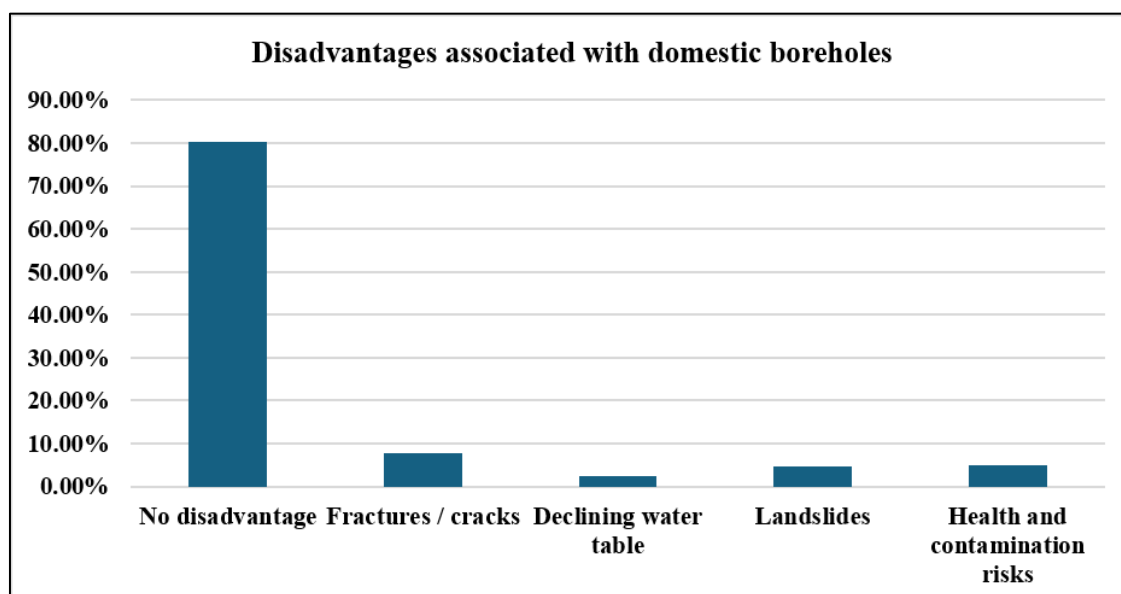


Figure 16: Reported disadvantages associated with domestic boreholes

3.17 Household suggestions for improving access to drinking water

The main feature of this section is the absence of suggestions from 249 households (65.0% of the sample). Among the proposals, State intervention and responsibility are most common, with 65 responses (17.0%). Water sharing between neighbours is suggested by 23 households (6.0%). Improvement or restoration of the SEG network is requested by 22

(5.7%), while 18 (4.4%) recommend building public boreholes. Finally, six households (1.6%) mention borehole maintenance, monitoring and regulation.

These suggestions concern public action, restoration of water services, collective facilities, neighbourhood solidarity and borehole oversight.

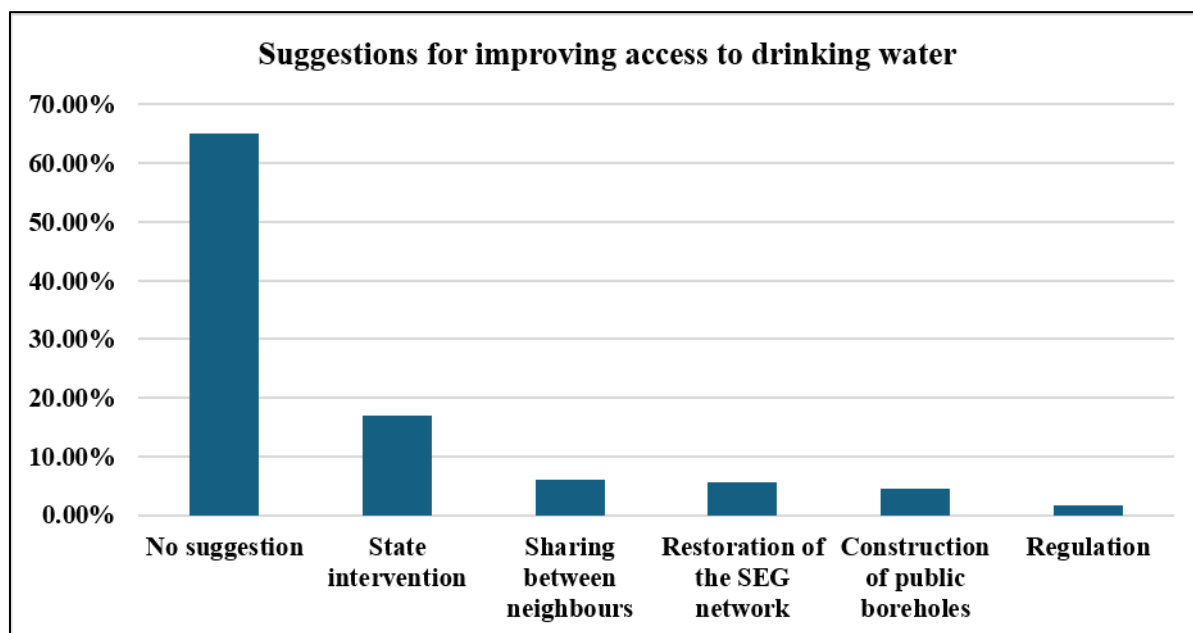


Figure 17: Household suggestions for improving access to drinking water

3.18 Summary of results

The survey first highlights the central role of boreholes in household supply: 79.6% of households use them exclusively, and 94.0% use them alone or alongside another source. At least one nearby borehole is reported by 74.93% of households. Only 3.7% report awareness of a State-built borehole in their neighbourhood. Technical information about the facilities is largely unavailable: depth is unknown to 77.02% of households, the drilling company to 86.16%, and daily operating time is unreported by 78.6%. These high levels of non-response or lack of knowledge need to be considered in the subsequent analysis. Regarding use and storage, 52.7% of households own a tank. The main capacities are 3,000 litres (58.6%) and 5,000 litres (29.6%). Borehole water is primarily used for domestic purposes, including all household needs. In addition, 21.4% of households report a conflict over access, 20.1% report stomach pain or diarrhoea, and 19.8% report at least one disadvantage associated with boreholes. These findings describe individual experiences and perceptions.

4 DISCUSSION

The survey across the study neighbourhoods shows that boreholes underpin domestic water supply. Of the 383 households, 305 (79.6%) report boreholes as their main source and 360 (94.0%) use them alone or alongside another source. This predominance should be understood as a household response to the limitations of collective services, rather than a technical preference. The data nevertheless remain self-reported: they describe experiences, trust and practices, without establishing whether the water is safe to drink or whether it caused the reported illnesses.

4.1 Boreholes as the main response to inadequate public services

The use of boreholes by 94.0% of households points, at least in part, to a hybrid urban system in which private infrastructure compensates for network deficiencies. This is consistent with earlier research in Conakry, which already showed households relying on groundwater alongside the urban network [6]. The report on Conakry's water supply [16] and aquifer modelling [17] indicate that demographic pressure, urban growth and service constraints have made independent abstraction more widespread. Research in Ratoma also links the increase in boreholes to inadequate public supply [7]. Lambanyi thus follows a longstanding trajectory in Conakry: boreholes have become a structural component of actual water provision, rather than an auxiliary source.

A similar pattern is observed in Lagos, where studies identify a gap between the statistical importance of self-supply and its limited visibility in public policy [5,18]. Across urban Africa, groundwater volumes abstracted directly by

households are substantially underestimated [4]. In Nairobi, private boreholes have been described as a temporary solution that becomes permanent [19], and as resilient sources when the network fails [20]. The high prevalence in Lambanyi therefore reflects a de facto privatisation of water security: households able to afford access either own a water facility or depend on a neighbour's.

Combining boreholes with wells (8.6%) or SEG water (5.5%) is part of a diversification strategy. It reduces disruption but also increases costs, handling and the possibility of mixing water of different qualities. Research shows that urban self-supply can sustain service continuity when financing, operation and sanitary oversight are transferred from the wider economy to households [21]. Access also needs to be assessed through the human right to water, considering availability, safety, physical accessibility, affordability and non-discrimination, rather than simply the presence of a source [8].

4.2 Private ownership neighbourhood relations and unequal access

Only 126 households (32.9%) own a borehole within their compound, whereas 94.0% use borehole water and 74.9% report at least one nearby. The gap between use and ownership reveals relationships of dependence, including family sharing, access through neighbours, purchases or negotiated access. This distinction is fundamental: apparently high borehole coverage does not mean that every household has independent, continuous and affordable access.

The 49 households (12.8%) reporting difficult access or refusal to share water, together with the 33 reporting neighbourhood conflicts, account for 21.4% of the sample. This is a substantial proportion and shows that social proximity does not remove social barriers. Research in Accra similarly emphasises that self-supply can serve underserved populations while creating diffuse responsibilities and power relations between owners and non-owners [8]. In Kumasi, self-supply performance varies with income, cost, reliability and local arrangements [22]. On the Kenyan coast, groundwater has been examined through a welfare framework: reliable and equitable facilities bring benefits, but can also reproduce economic vulnerabilities [23].

The absence of reported conflict among 78.6% of respondents suggests that local solidarity functions in practice. The proposal to share water between neighbours, made by 23 households (6.0%), further confirms the importance of these local norms. However, the absence of reported conflict does not necessarily imply equal or free access; some limitations may be accepted as normal and rarely expressed in a survey. Groundwater governance analysis therefore needs to include users' daily lives, beyond legal and technical frameworks alone [24].

4.3 Borehole density and perceptions of pressure on groundwater

Among the surveyed households, 287 (74.9%) report at least one borehole nearby, and 148 (38.6%) report three or more. This proximity provides a visible indication of increasing abstraction-point density. It is consistent with the thesis inventory of 1,395 boreholes over 21.3 km², or approximately 65.5 boreholes per km². More boreholes provide immediate individual security, but turn the shared aquifer into a resource exploited by many poorly coordinated actors.

Research in Ratoma reports that borehole proliferation can affect aquifer quantity [7]. In the Nairobi Aquifer System, rapid urbanisation and increased abstraction are associated with declining groundwater levels [25]. Sustainability depends on recharge, transmissivity, pumped volumes and monitoring [26]. Globally, rapid and sometimes accelerating declines have been documented in many aquifers, although appropriate policies and managed recharge can reverse some trends [27].

In Lambanyi, only nine households (2.3%) perceive a decline in the water table. This low proportion does not necessarily contradict hydrodynamic pressure. Falling groundwater levels are difficult to observe without monitoring and may be perceived indirectly through longer pumping times, reduced discharge or deeper facilities. Community perceptions therefore need to be complemented by groundwater-level data, pumping tests and estimates of abstraction volumes.

4.4 Storage service continuity and sanitary safety

Among the 126 borehole owners, 124 (98.4%) have a tank. Across the sample, 202 households (52.7%) report a tank, indicating that households without their own borehole also store water obtained elsewhere. The main capacities are 3,000 L (58.4% of reported capacities) and 5,000 L (29.7%). Storage is a rational response to power cuts, discharge variations and peak demand. In developing countries, consumers are not expected to pump water directly from the connected distribution pipe; instead, water should first pass from the building's entry point to a storage tank and then into the building's plumbing [28]. Storage improves availability at the point of use and probably helps explain why 85.1% of households report no availability or quality problem. This positive assessment needs qualification: storage can maintain continuity but degrade quality if tanks are poorly covered, rarely cleaned or subject to contamination during withdrawal. Research in many Asia-Pacific countries also shows that self-supply safety depends on the whole

chain from abstraction to use [29]. Guidelines emphasise risk management at the source, during pumping, in the tank, throughout distribution and in household practices [30]. Water considered clear at the well can therefore become contaminated again during transport or storage.

Filling times support this functional interpretation: 82.2% of households providing a duration fill their tanks within one to two hours. This suggests that discharge is sufficient for routine use in most cases. However, filling time is a composite indicator affected by tank volume, pump power, pumping head and dynamic water level. It should not be used on its own as a measure of aquifer yield.

4.5 The gap between perceived and measured water quality

Most respondents, 326 (85.1%), report no availability or quality problem; 24 (6.3%) report water shortages, while 20 (5.2%) mention cloudy water. This high level of satisfaction probably reflects the practical value of boreholes: they are close by, involve no waiting time and generally appear satisfactory. Sensory perceptions, however, mainly concern colour, turbidity, odour and taste. Invisible microbiological or chemical contaminants cannot always be detected in this way.

The contrast with the thesis analyses is clear: eight of the 58 tested boreholes contain faecal coliforms, 38 of 58 have a pH below 6.5, and localised anomalies concern turbidity, nitrate or metals. Earlier work documented nitrate and faecal contamination in Conakry groundwater [6]. Other research reported variations in the physicochemical and bacteriological quality of the city's water sources [31], and highlighted groundwater vulnerability near inadequately controlled landfills [32]. In Kankan, comparisons between borehole, well, tap and river water also show quality differences [33]. Together, these studies indicate that a groundwater origin does not always ensure drinking-water safety.

The same distinction is documented elsewhere in Africa. Studies identify contamination associated with on-site sanitation, waste, urbanisation and borehole construction in sub-Saharan cities [34], and the effects of semi-formal urban settlements on groundwater quality in Zimbabwe [35]. In Ouagadougou, microbiological and physicochemical pollution has been linked to several environmental and sanitary factors [36]. In Tanzania, seasonal variations in coliform abundance show that a single sampling campaign may underestimate or overestimate annual risk [37]. Research in Cape Coast identifies on-site sanitation and saline intrusion [38], while work in Dar es Salaam reports both seawater intrusion and nitrate pollution [39]. These comparisons are particularly relevant to Lambanyi, a densely urbanised coastal area where boreholes, septic tanks and waste coexist. They support seasonal and spatial monitoring, but do not allow every anomaly to be automatically attributed to a specific source without information on distances, depth, sealing and tracing.

4.6 Digestive symptoms and perceptions of health risk

Most households (79.9%) report no water-related illness. Stomach pain is mentioned by 52 (13.6%), and diarrhoea by 25 (6.5%), totalling 20.1% across the two groups. These reports raise a health concern but do not establish causation. Symptoms are self-reported, without clinical confirmation, a recall period or a control group, and may relate to food, hygiene, storage or other water sources.

The presence of faecal coliforms in some boreholes nevertheless makes a water-related explanation plausible. Studies show that urban groundwater can be affected by faecal discharges when sanitary protection and sanitation are inadequate [39,36,35]. The most rigorous interpretation is therefore that the reported symptoms are consistent with a microbiological hazard, rather than evidence of its effects. An analytical study would need to link each household's exposure to a tested borehole, storage practices and clinical incidence.

4.7 Perceived disadvantages and social and environmental risks

The 19.8% of households reporting at least one disadvantage show some awareness of externalities. Cracks or fractures (7.8%) are followed by health threats (5.0%), landslides (4.7%) and a declining water table (2.3%). These responses describe perceived associations. Cracks and ground fractures were observed in the Nongo Taady area and were attributed to boreholes in view of their concentration there.

Limited awareness of quantitative and health risks may reflect the immediate, visible benefit of available water, while contamination, saline intrusion and cumulative drawdown are delayed and often invisible. Research in Cape Town describes cities as hybrid systems in which private boreholes interact with sanitation, planning and ecosystems [40]. This perspective is relevant to Lambanyi: benefits are individual, while the costs of declining groundwater levels, cross-contamination and conflict are collective.

4.8 Governance technical knowledge and community expectations

Only 14 households (3.7%) know of a State-built borehole in their neighbourhood, while 323 (84.3%) respond negatively. This perceived withdrawal of public provision helps explain the spread of private solutions. Of the 126 owners, 38 (30.2%) do not know their borehole's depth and 73 (57.9%) do not know the drilling company. These proportions should be related to the 126 owners, rather than all 383 households. They reveal weak technical traceability, which can complicate maintenance, oversight and responsibility for failures or contamination. Research reports that fissures oriented in several directions appeared in the Husu tectonic zone as a result of groundwater overexploitation [41].

Studies describe similar institutional invisibility in Accra and Lagos [5,42,18]. Research also argues that African governance remains too focused on formal parameters and insufficiently attentive to users' actual practices [24]. Coordination between water, sanitation, urban planning and the environment has therefore been recommended [40]. In Lambanyi, these approaches would involve a georeferenced borehole register, approval of drilling companies, retention of drilling logs and pumping-test records, and joint monitoring of groundwater quantity and quality.

Household suggestions point in the same direction: 65 (17.0%) favour State intervention, 22 (5.7%) improvements to the SEG network, 18 (4.7%) public boreholes, 23 (6.0%) sharing between neighbours, and six (1.6%) maintenance, monitoring or regulation. The 249 households (65.0%) offering no suggestion should not be assumed to be satisfied. Their responses may reflect difficulty identifying the competent authority, lack of confidence in public action or, more likely, reliance on self-supply. The Water Code provides a general framework for water distribution, but the challenge lies in local implementation [43].

5 CONCLUSION

Boreholes play a crucial role in water supply in the four study neighbourhoods of Lambanyi: 94.0% of respondents use borehole water, while only 32.9% own a borehole. Access therefore depends largely on facilities outside the household compound. Storage is reported by 52.7% of households and 98.4% of borehole owners, alongside pumping and domestic water use.

Generally favourable perceptions of availability and quality coexist with access difficulties or conflicts reported by 21.4% of households. Reported digestive symptoms and social and environmental disadvantages require further investigation. They demonstrate neither contamination at each abstraction point nor a direct effect of boreholes on health or ground movement.

Improvements to public water services should be accompanied by better coordination of private abstraction, stronger technical traceability and information on protecting facilities and storage. Analyses at the abstraction point and the point of use, together with a survey of the economic and social conditions of access, would clarify supply security. Coding and denominator discrepancies need to be resolved against the survey database before the article is submitted.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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