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Water management and supply for the population of the urban commune of kissidougou

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Abstract

This research focuses on the water supply for the population of the urban commune of Kissidougou. The survey reveals that water supply points are numerous and varied. According to our field study of 240 households across the commune urban, 35% of the population obtains water from boreholes, followed by 34% from wells and boreholes, 16% from wells alone, and 13% from public connections and boreholes. Regarding water transport, the survey shows that 33% of children and women transport water, compared to 32% of women alone, followed by 21% of children, 4% of children and men, and 3% of men, women, and children together. Finally, for the different types of water uses, the result shows that 19% of the population dispose of laundry water in the street, 18% dump dishwashing and cooking water in the street and 17% dispose of shower water in wells.

However, 5% of the population throw shower water into the street and cooking water into the yard and the other 4% dispose of dishwashing and laundry water in the yard of their concessions, only 2% dump dishwashing water into wells.

Keywords: Management; Supply; Population; Household; Water; Kissidougou

1. Introduction

Water management is a major global challenge. Approximately 700 million people, or 9% of the world's population, face water scarcity, according to the WHO and UNICEF. This situation is exacerbated by population growth, rapid urbanization, and climate change. It is projected that by 2050, 1.8 billion people could be living in areas affected by total water scarcity, while two-thirds of the world's population could be subject to water stress. [4, 5, 6]

In Guinea, water resource management is a major, yet also difficult, problem, relying on complex governance and insufficient infrastructure. Although access to safe drinking water has increased, problems of pollution, limited production capacity, and water losses persist, exacerbated by rapid population growth, particularly in urban areas. [4, 5]

In Kissidougou, water supply requires coordination among technical services, local communities, and partners such as UNICEF, based on national water management policies. Challenges include the exploitation of natural resources (groundwater and surface water), water treatment, the development of distribution infrastructure, cost management, and community involvement. [4, 5, 6] However, management relies on a national policy, the Guinean Water Company (SEG), and decentralized management structures, with major investment projects, such as the Guinean Urban Water

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Project (PUEG), aimed at improving access to and the efficiency of services. To contribute to a potential solution to this scourge in the urban commune of Kissidougou, we deemed it necessary to conduct research on the topic of "Water Management and Supply for the Population of the Urban Commune of Kissidougou." To carry out this study, we structured it as follows: methods and materials, results and discussion, followed by a conclusion.

2. Methods and materials

2.1. Study Area

The prefecture of Kissidougou is one of the prefectures of Guinea, located approximately 600 kilometers from the capital, Conakry, in the Faranah administrative region. It lies between 9° 11′ North latitude and 10° 06′ West longitude and covers an area of 8,872 km^2 with an average altitude of 525 meters. According to the Köppen-Geiger classification, Kissidougou has a savannah climate with a dry harmattan and characterized by the alternation of two main seasons, a dry season and a rainy season. The prefecture of Kissidougou experiences significant rainfall almost year-round, averaging 1083.9 mm annually. The dry season lasts from November to March. The average annual temperature in Kissidougou is 26.2°C. Hydrographically, the main waterway flowing through the prefecture is the Niandan River, followed by smaller streams. [5] The population of the urban commune of Kissidougou, as recorded in the 2014 census, was estimated at 109,959 inhabitants, with an average annual growth rate of 5.10% over the 12-year period. It is therefore the sixth most populous city in the country, after Conakry, Nzérékoré, Guéckédou, Kankan, Kindia, and Boké. [4, 5, 6].

In Kissidougou, we meet several different ethnic groups and dialects including Kouranko, Kissi, Lélé, Malinké, Pular and others. The city includes twenty-four (24) districts which are: Hamdallaye, M'Ballia, Hérémakono, Timbo, Kénèma, Missira, Gbanban, Douninkono, Madina I, Madina II, Sogbé I, Sogbé II, Sogbé III, Korodou I, Korodou II, Yassafè Koura, Yassafè Koro, Ernesto, TP, Limanya, Marah, Kérédou, Daresalam and Farako.

The prefecture of Kissidougou is subdivided into thirteen (13) sub-prefectures, namely: Kissidougou-Centre, Albadaria, Banama, Bardou, Beindou, Fermessadou-Pombo, Firawa, Gbangbadou, Kondiadou, Manfran, Sangardo, Yendé-Millimou and Yombiro. [4, 5].

2.2. Meteorological data for the prefecture of Kissidougou

2.2.1. Temperature

Daily maximum temperatures increase by 2°C, from 27°C to 29°C, rarely falling below 25°C or exceeding 34°C. Daily minimum temperatures decrease by 2°C, from 20°C to 18°C, rarely falling below 15°C or exceeding 22°C. The highest average daily minimum temperature is 21°C on October 11. For reference, on March 21, the hottest day of the year, temperatures in Kissidougou generally range between 21°C and 33°C, while on January 1, the coldest day of the year, they range between 16°C and 29°C. [4, 5, 6].

2.2.2. Cloud Cover

Autumn in Kissidougou is characterized by rapidly decreasing cloud cover, with the percentage of total or partial cloud cover decreasing from 78% to 48%. The clearest day of autumn is November 30th, with clear, mostly clear, or partly cloudy skies 52% of the time. For reference, on August 15, the cloudiest day of the year, the probability of overcast or cloudy skies overall is 80%, while on January 6, the clearest day of the year, the probability of mostly clear or partly cloudy skies is 64%. [4, 5]

2.2.3. Precipitation

A day of precipitation is a day on which at least 1 millimeter of water accumulates. In Kissidougou, the probability of precipitation during the autumn decreases very rapidly, starting the season at 85% and ending at 7%. For example, the highest probability of precipitation of the year is 88% on August 22 and the lowest is 1% on January 1. [4, 5].

2.2.4. Rainfall

To show the variation throughout the season and not just the monthly totals, we present the rainfall accumulation over a 31-day moving average centered on each day. The average rainfall over a 31-day period in autumn in Kissidougou decreases very rapidly, beginning the season at 362 millimeters and rarely exceeding 622 millimeters or falling below 84 millimeters, and ending the season at 14 millimeters and rarely exceeding 37 millimeters or falling below 0 millimeters. [4, 5].

2.2.5. Sunlight

During autumn in Kissidougou, the length of the day decreases. From the beginning to the end of the season, the length of the day decreases by 39 minutes, which corresponds to an average daily decrease of 26 seconds and a weekly decrease of 3 minutes and 4 seconds. The shortest day of autumn is November 30th with 11 hours and 38 minutes of daylight, and the longest day is September 1st with 12 hours and 17 minutes of daylight. The earliest sunrise in autumn in Kissidougou occurs at 6:28 AM on October 13th, and the latest sunrise occurs 12 minutes later at 6:39 AM on November 30th. The latest sunset occurs at 6:49 p.m. on September 1st, and the earliest sunset occurs 33 minutes earlier at 6:16 p.m. on November 15th. For reference, on June 21st, the longest day of the year, the sun rises at 6:22 a.m. and sets 12 hours and 40 minutes later at 7:01 p.m., while on December 22nd, the shortest day of the year, it rises at 6:51 a.m. and sets 11 hours and 35 minutes later at 6:26 p.m. [3, 4, 5].

2.2.6. Humidity

The probability of a given day being humid in Kissidougou decreases very rapidly during the autumn, dropping from 100% to 37% over the course of the season. For reference, on August 16, the heaviest day of the year, the climate is humid 100% of the time,

while on January 1, the least humid day of the year, the climate is humid 5% of the time. [3, 4, 5]

2.2.7. Wind

In Kissidougou, the meteorological service reports wind speed and direction at 10 meters above ground level. The wind observed at a given location depends heavily on local topography and other factors, and instantaneous wind speed and direction vary more than hourly averages. The average hourly wind speed in Kissidougou decreases during the autumn, dropping from 10.1 kilometers per hour to 7.8 kilometers per hour over the course of the season. For example, on August 8, the windiest day of the year, the average daily wind speed is 11.5 kilometers per hour, while on October 26, the calmest day of the year, the average daily wind speed is 6.8 kilometers per hour. The lowest average daily wind speed during the autumn is 6.8 kilometers per hour on October 26. [4, 5, 6] The prevailing wind direction in Kissidougou during the autumn is primarily from the west from September 1 to September 17, from the south from September 17 to October 7, and from the east from October 7 to November 30. [2, 5, 8, 9].

2.2.8. Solar Radiation

The average daily incident shortwave solar radiation at Kissidougou increases gradually during autumn, rising by 0.5 kWh from 4.7 kWh to 5.2 kWh over the course of the season. [4, 5, 6].

2.2.9. Topography

The geographic coordinates for Kissidougou are: 9.185° latitude, -10.100° longitude, and 530 m altitude. The topography within 3 kilometers of Kissidougou shows only slight variations in altitude, with a maximum variation of 56 meters and an average altitude above sea level of 524 meters. Within 16 kilometers, there are only slight variations in altitude (268 meters). Within 80 kilometers, there are very significant variations in altitude (1072 meters). The area within a 3-kilometer radius of Kissidougou is covered by cultivated land (47%) and artificial surfaces (45%), within a 16-kilometer radius by trees (51%) and cultivated land (25%), and within an 80-kilometer radius by trees (65%) and pastureland (25%). [5, 7, 8, 9].

Figure 1 shows a photograph of the map of the urban commune of Kissidougou.

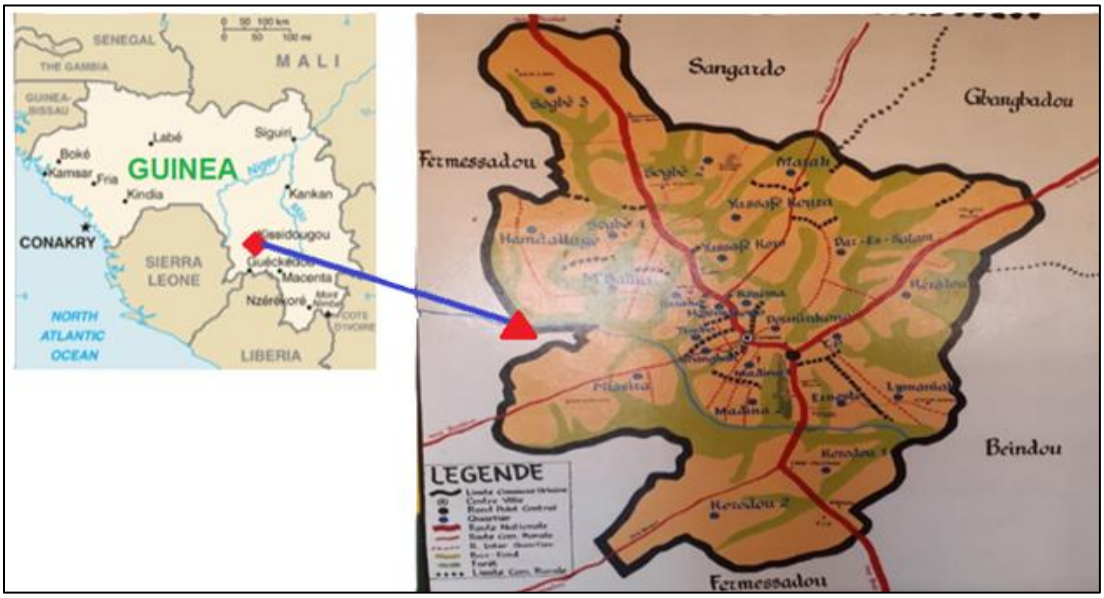


Figure 1 Map of the urban commune of Kissidougou

3. Methods

To carry out this research, we adopted a methodology based on the approach and involvement of all stakeholders in water supply, particularly SEG, and it revolves around three main points, namely:

- Preliminary work;
- The fieldwork phase;
- The data processing and feasibility study phase.

The method used for household sampling was probability random sampling.

For the analysis of the sample and the processing of household data, we used Excel accounting software.

In order to obtain a representative sample for the urban commune of Kissidougou, sampling points at the household level were selected.

For this study, ten households were chosen from each of the twenty-four (24) neighborhoods of the urban commune, for a total of two hundred and twenty-four (240) households included in our survey.

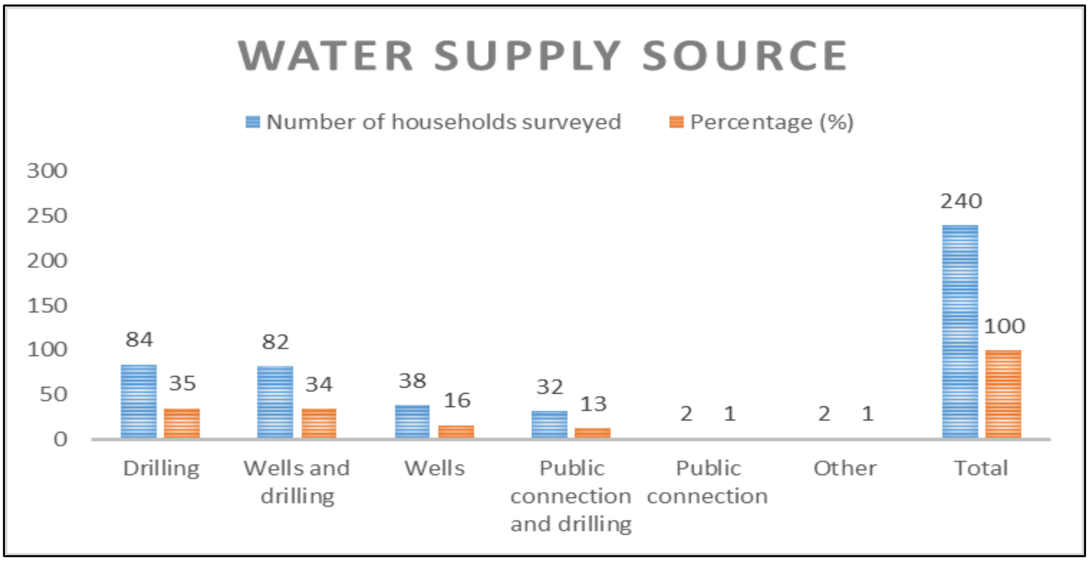
4. Results

The sources of water supply are multiple and varied, namely: boreholes, the supply network, public connections, ordinary wells, improved wells, mineral water, streams, the Niandan River and its tributaries in particular.

In this section, the survey focused on the different water supply sources, their various uses, types of transport (children, women, men), containers used and their type, storage containers, and storage locations.

The graphs below represent the main characteristics of the water supply for the surveyed population.

Graph 1 represents the water supply sources for households.

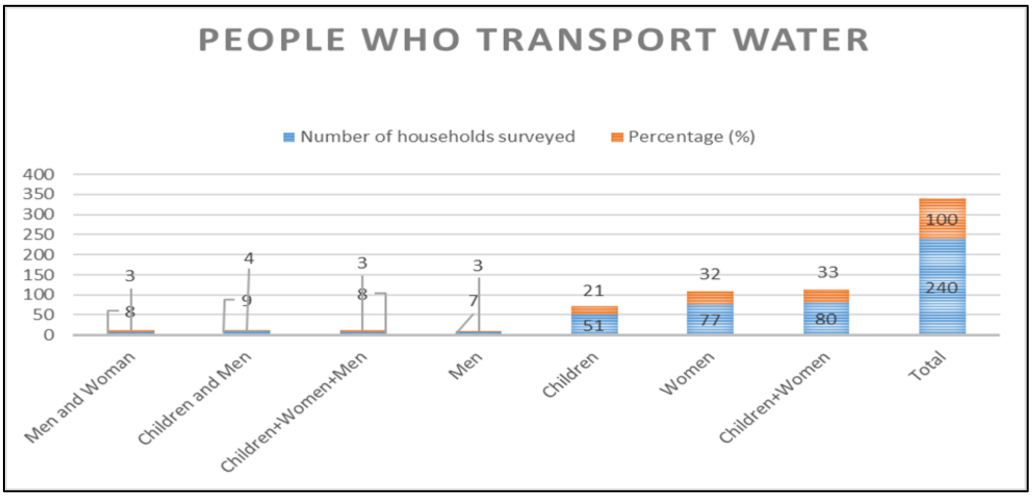


Source: 2024-2025 Surveys

Figure 2 Water Supply Sources of Surveyed Households

This figure shows that 35% of the surveyed population obtains their water from boreholes, followed by 34% from wells and boreholes, 16% from wells alone, 13% from public connections and boreholes, and only about 1% from other sources and public connections.

Figure 3 shows the individuals who transport water to the surveyed households.



Source: 2024-2025 Surveys

Figure 3 People who transport water at the household level in surveyed areas

This figure shows that 33% of children and women transport water, compared to 32% of single women, followed by 21% of children, 4% of children and men, and 3% of men, women, and children.

Table 1 shows the different uses of water by the households surveyed.

Table 1 Different Water Uses by Surveyed Households

N°	Type of Water Use	Number of Households	Percentage (%)
1	Public connection – Drinking	1	0.41
2	Public connection – Cooking	1	0.41

3	Public connection – Toilet use	5	1.99
4	Public connection – Laundry	5	1.99
5	Public connection – Dishwashing	5	1.93
6	Public connection – Other uses	4	1.79
7	Well – Drinking	7	2.75
8	Well – Cooking	7	2.75
9	Well – Toilet use	20	8.32
10	Well – Laundry	20	8.32
11	Well – Dishwashing	20	8.32
12	Well – Other uses	20	8.32
13	Borehole – Drinking	33	13.55
14	Borehole – Toilet use	15	6.40
15	Borehole – Laundry	15	6.33
16	Borehole – Dishwashing	15	6.33
17	Borehole – Cooking	33	13.55
18	Borehole – Other uses	14	5.85
19	Other source – Dishwashing	0	0.07
20	Other source – Cooking	0	0.07
21	Other source – Toilet	0	0.07
22	Other source – Latrine	0	0.07
23	Other source – Drinking	0	0.07
24	Other – Miscellaneous	1	0.34
Total		240 households	100%

Source: Household survey, 2024–2025

Legend – table 1

- **Public connection – Drinking:** use of piped water for drinking
- **Public connection – Cooking:** use of piped water for cooking
- **Public connection – Toilet use:** water used for toilets
- **Public connection – Laundry:** water used for clothes washing
- **Public connection – Dishwashing:** water used for washing dishes
- **Well – Drinking:** drinking water drawn from wells
- **Well – Cooking:** cooking water drawn from wells
- **Well – Toilet use:** water used for toilets from wells
- **Well – Laundry:** laundry water from wells
- **Well – Dishwashing:** dishwashing water from wells
- **Borehole – Drinking:** drinking water from boreholes
- **Borehole – Cooking:** cooking water from boreholes
- **Borehole – Toilet use:** toilet water from boreholes
- **Borehole – Laundry:** laundry water from boreholes
- **Borehole – Dishwashing:** dishwashing water from boreholes
- **Other:** any alternative or unspecified water source

This table shows that the different water uses by the surveyed population are as follows: 14% use borehole water for cooking and drinking, while 8% use well water for toilets, latrines, washing dishes, and other uses; 6% use borehole water only for toilets, latrines, and washing dishes; 5% use borehole water for other uses; 3% use well water for cooking and drinking; 2% use public water connections for toilets, latrines, washing dishes, and other uses; and only 1% use public connections for cooking and drinking, and other uses for drinking, cooking, toilets, and washing dishes.

Table 2 presents the wastewater disposal methods used by the surveyed households.

Table 2 Modes of Domestic Wastewater Disposal

No.	Disposal Method	Number of Households	Percentage (%)
1	Bathwater – Well	40	16.65
2	Bathwater – Latrine	1	0.60
3	Bathwater – Street	13	5.48
4	Bathwater – Drainage channel	0	0.10
5	Bathwater – Septic tank	2	0.90
6	Bathwater – Yard	1	0.60
7	Bathwater – Other	2	0.90
8	Dishwashing water – Well	4	1.50
9	Dishwashing water – Latrine	0	0.00
10	Dishwashing water – Street	44	18.25
11	Dishwashing water – Drainage channel	0	0.20
12	Dishwashing water – Septic tank	0	0.30
13	Dishwashing water – Yard	11	4.39
14	Dishwashing water – Other	1	0.60
15	Laundry water – Well	3	1.20
16	Laundry water – Latrine	0	0.20
17	Laundry water – Street	45	18.64
18	Laundry water – Drainage channel	0	0.00
19	Laundry water – Septic tank	0	0.30
20	Laundry water – Yard	10	3.99
21	Laundry water – Other	2	0.50
22	Cooking water – Well	3	1.20
23	Cooking water – Latrine	0	0.00
24	Cooking water – Street	43	17.85
25	Cooking water – Drainage channel	0	0.10
26	Cooking water – Septic tank	0	0.20
27	Cooking water – Yard	12	4.89
28	Cooking water – Other	2	0.50
Total		240 households	100%

Source: 2024-2025 Surveys

This table reveals that the domestic wastewater disposal methods of the surveyed population are characterized by a significant number of people disposing of laundry water in the street (19% out of a total of 240), followed by 18% who dump dishwashing and cooking water in the street, 17% who dispose of shower water in wells, while 5% of the population throws shower water in the street and cooking water in their yards, and another 4% of respondents dispose of dishwashing and laundry water in their yards, 2% dump dishwashing water in wells, and only 1% dispose of shower water in latrines or other facilities.

5. Discussions

In Kissidougou, water supply has both positive (economic and social development) and negative (scarcity, resource degradation, conflict) consequences. Comparing our results with those of previous studies worldwide, it appears that the consequences experienced in Kissidougou are similar to those in other cities. For example, we can cite the following:

In February 2023, Feldman highlighted that, due to urban sprawl, city dwellers live far from sources of drinking water. Underground pipes are installed to deliver water where it is needed, but this system is difficult, disruptive, and expensive to maintain. [2, 3, 5, 8].

For a political analysis, Julie McClatchie, writing for Oxfam-Québec, estimates that by 2025, up to 2.4 billion people will be living in water-scarce areas. This climate degradation will have a disproportionate impact on women, who perform more than 75% of care work worldwide. In several countries, the responsibility for fetching water, wood, or food often falls on women and girls. [2, 4, 5].

West Africa is relatively well endowed with water resources, with over one trillion cubic meters of freshwater renewed annually through the region's normal hydrological cycle (Niasse, 2005). [4, 5, 6] Even considering only internal renewable resources (i.e., those generated from endogenous rainfall) and thus excluding runoff entering West Africa from, for example, the Central African Republic and Cameroon, each West African had statistically approximately 4,059 m^3/year available in 2005. However, it is widely accepted that beyond 1,700 m^3/year, a society's development is theoretically not constrained by a problem of access to water (Lasserre and Descroix, 2002). [2, 5, 6] Moreover, the pressure on the resource is currently low with a utilization rate (ratio between annual withdrawals and available renewable resource) of only between one and three percent. This rate could, however, increase six fold by 2025, primarily due to population growth (Niasse, 2005). For comparison, Peter Gleick (1993) of the Pacific Institute for Studies in Development, Environment, and Security placed the concern threshold at a supply/demand ratio of one-third. However, inadequate management and rapid population growth can lead to significant pressure on existing resources, ecosystem degradation, and increased social tensions. [1, 2, 3].

6. Conclusion

Globally, and especially in Africa, water supply problems are complex, exacerbated by climate change, mismanagement, corruption, and population growth, leading to community and interstate tensions (such as those along the Nile) regarding transboundary resources and infrastructure. Poor governance, waste, lack of investment, and armed conflict worsen physical and economic scarcity, affecting access to drinking water and sanitation for millions of people and necessitating strengthened regional cooperation and investments in water resilience. Thus, this study highlights water management and supply in Kissidougou as a major challenge, exacerbated by population growth, urbanization, and climate change, which threatens billions of people with water scarcity and stress.

It is important to remember that this research also allowed us to understand that financial resources and water resources are closely linked. Furthermore, it showed us that a city can develop despite water scarcity, either by pumping water over increasingly greater distances or by investing in technologies such as desalination. However, many rapidly growing cities are also subject to economic stress and can hardly guarantee a sufficient water supply for their citizens without resorting to international aid and investment.

In conclusion, it is important to emphasize that water is altered by human activity, whether domestic, industrial, artisanal, or agricultural. After use, water is considered "polluted" and must be treated before being released back into the environment. Without this treatment, it could cause serious damage because the natural purification capacity of waterways consumes oxygen from the river.

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