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Assessment of hydraulic performance and inequalities in access to the Yopougon-Koweït drinking water supply network (Abidjan, Côte d'Ivoire)

ABSTRACT

The drinking water supply in the Yopougon-Koweït neighborhood faces challenges in terms of accessibility and performance of the drinking water supply network. This study aims to evaluate the hydraulic performance of the drinking water supply network in the Yopougon-Koweït neighborhood in Abidjan. The methodological approach is based on data relating to water production and water demand from the population, collected by SODECI in 2010, 2015, and 2022. The results reveal a significant but incomplete improvement in access to drinking water. The access rate rose from 39% to 68% between 2015 and 2022. Analysis of the state of the network highlights its aging and poor hydraulic performance, despite progress. The network's efficiency improved from 32% to 62%. Linear losses have been reduced from 88 to 28 m³/day/km. However, the network has a very heterogeneous and fluctuating pressure profile, ranging from -1.25 to 32.1 mCE. This situation creates inequalities in access between sub-neighborhoods.

Keywords: Water supply network, water drinking, hydraulic performance, Yopougon-Koweït

INRODUCTION

Water is an indispensable element for sustaining life and maintaining good health. It isnowwidelyacknowledged as a fundamentalhuman right (Yao, 2022). It isevidentthatSustainableDevelopment Goal 6 (SDG 6) has been instrumental in guiding the United Nations (UN) towardsitscommitment to ensureuniversalaccess to water and sanitation by 2030, in addition to promotingsustainable water resource management (UN Water, 2023).

In sub-SaharanAfrica, approximately 30% of the urban population resides in informalsettlements (WHO/UNICEF, 2023). As stated by UN Water (2019), inhabitants of suchsettlementsfrequentlyencounterdifficulties in accessingfundamentalamenities, including potable water. This situation isevident in Côte d'Ivoire, a developing country where populations still have insufficientaccess to safedrinking water. This is in spite of the factthat acceptable coverage rates have been achieved.

Abidjan, the largest city in Côte d'Ivoire and the fourthlargest in Africa, is no exception in terms of the difficulty of accessing water (Goé et al., 2024 ; Goé et al., 2025). It isestimatedthatthisregionis home to over 30% of the Ivorian population, and it has an annualgrowth rate of 2.9% (INS, 2021). Despiteconstitutinglessthan 1% of the national territory, itisresponsible for 60% of Côte d'Ivoire's total drinking water production and consumption. In 2020, the volume of water produced in Côte d'Ivoire was 302,814,000 m³, of which 227,668,000 m³ wasbilled, resulting in a loss of 7,514,600 m³ (ONEP, 2020).

The Koweït neighbourhood, the setting for thisstudy, has a population of 46,932, comprising 7,822 households, with an averagehousehold size of 6 people (INS, 2021). The population subscribing to RéPEPisestimated at 5,483 (SODECI, 2022). In the context of inadequate water infrastructure, households have been observed to adopt alternative strategies to compensate for the inconsistency of supply (Angueletou-Marteau, 2009).

Indeed, a surveyrevealedthat 59% of householdsobtainedtheir water supplyfromresellerswhohadconnectedillegally and weretherefore not billed by SODECI.

However, thismethod of supply carries risks of water contamination linked to the quality of the pipes used, water collection, transport, and storage at home (Konan et al., 2011). The averagecost of households' compensatorystrategiesis five times higherthantheirquarterly water bill, representing at least 10% of theirmonthlyincome (Angueletou-Marteau, 2009).

A studyconductedin 2010 on network performance in the sameneighbourhooddemonstratedthat for a daily water production of 2,450 m^3, a mere 706 m^3 wasbilled, representing a loss of 61% of the water supplied. This losswasattributable to 59% of householdsthatobtainedtheir water exclusively and fraudulentlyfromresellers. This has resulted in considerablefinanciallosses for the water sector, estimated at 169,190,525 CFA francs per year (Touré et al., 2013). It is vital to acknowledge the significance of access to water for the population of Yopougon-Koweït in order to ensuretheirwell-being. Therefore, the primary objective of thisstudyis to evaluate the performance of the drinking water network in the Yopougon-Koweït neighbourhood. This willensuresustainableaccess to water for the population of thatneighbourhood.

2. MATERIAL AND METHODES

2.1 Study area

The Yopougon-Koweït neighbourhoodislocated in southern Côte d'Ivoire, between longitudes 4°3'0" and 4°3'36" West and latitudes 5°18'15"N and 5°19'20"' N (see Figure 1). The area underconsiderationis 1.7 km², and the population isestimated to be 46,932 inhabitants (INS, 2021).

Yopougon-Koweït isbordered to the north by the Toit Rouge neighborhood, to the south by the Ebrié lagoon, to the east by Santeneighborhood, and to the west by Camp Militaire neighborhood. It issubdividedinto five sub-neighborhoods: Johannesburg to the north, Ravin to the northeast, Konan Ferrand and Sante Extension to the southwest, and Sous-Koweït and Gouro to the southeast.

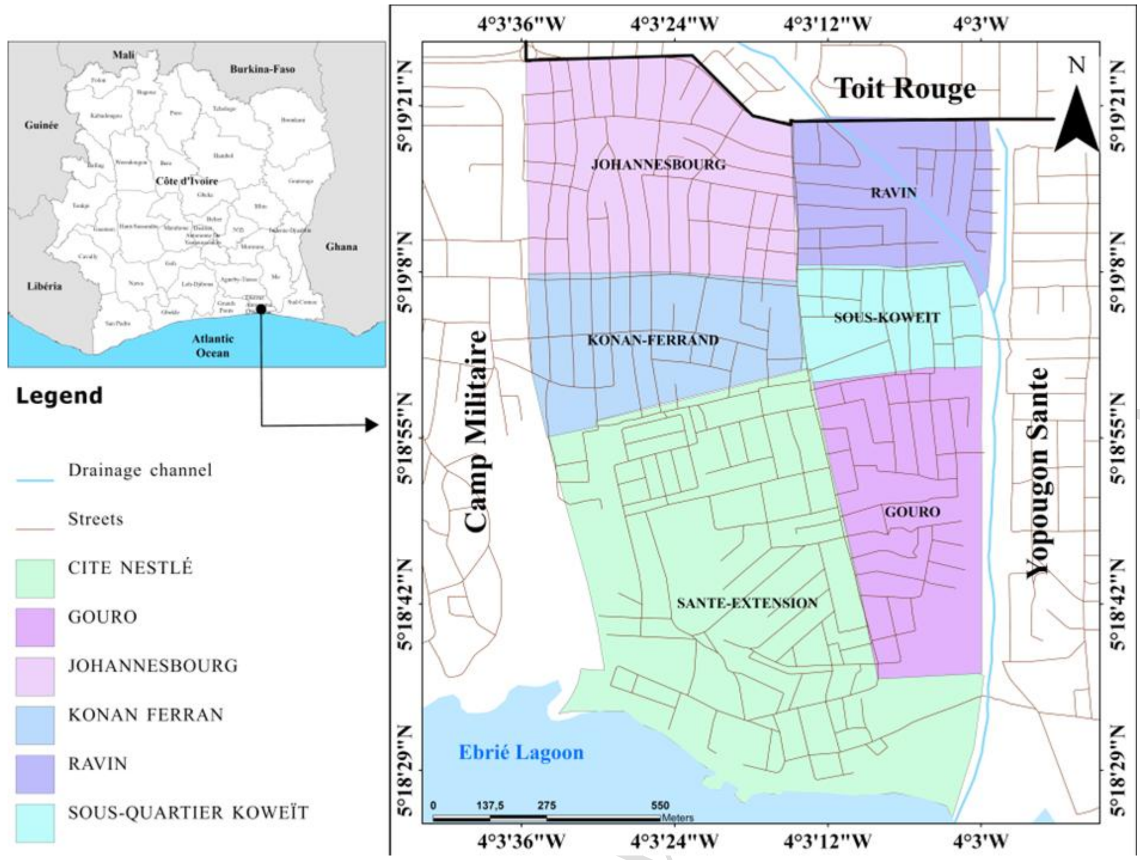

Figure 1: Study area

2.2 Data

This studyrequiredsociodemographic data and dataondrinking water supply. The latter included the number of subscribers, cancellations, and the volumes distributed, consumed, and billed for the years 2010, 2015, and 2022. Field surveyswereconductedusing an interview guide, while data processing and analysiswereperformedusing Excel 2013 software.

2.3 Methodes

2.3.1 Evaluation of subscriberdensity

Subscriberdensityis a metricthat quantifies the number of subscribers per unit of network length. The application under discussion enables the distribution of subscribersacross the water distribution network to beassessed, and the network to becharacterised in terms of urban planning. This densityisexpressed in subscribers per kilometer (subscribers/km). The calculationisderivedfrom the followingequation:

$$D = \frac{number\ of\ subscribers}{network\ length} \text{ (Eq 1)}$$

2.3.2 Estimation of domestic water consumption in the neighborhood

Population consumptionwascalculatedbased on specificconsumptionobtainedfrom water volumes billedin 2015 and 2022.Specificconsumption (equation 2) iscalculatedfrombilled volumes using the Krayenbuhl formula (1993):

$$SC = \frac{Vc}{365 \times \bar{T} \times A} \quad \text{(Eq. 2)}$$

Avec :

SC : Specificconsumption ;
Vc : Annual water volume consumed ;
$\bar{T}$: Averagehousehold size ;
A : Number of subscribers.

2.3.3 Estimation of water loss

The approachconsisted of comparingdailyconsumption data determinedfrom the volume of water consumedsupplied by SODECI with the daily volume of water produced. This method made it possible to evaluate the performance of the Yopougon-Kuwait water supply system.

2.3.4 Performance indicatorassessment

- **Technical network efficiency or billing ratio**

The technicalefficiency of the drinking water network is an indicatorthatmeasures the efficiency and performance of the network. This ratio isdefined as the proportion of water consumed by subscribers relative to the total water input into the network, as depicted in equation 3 (Hugues, 2000). This isdenoted by the letter η and expressed as a percentage (%).

$$\eta = \frac{consumed \;\; volume}{distributed \;\; volume} \times 100 \quad \text{(Eq. 3)}$$

- **Linearconsumption index (LCI)**

It represents the total volume of consumers per linearmeter of pipes. It isexpressed in cubicmeters per day per kilometer (m^3/day/km) and isused to classify the type of network. In thisstudy, itisgiven by the followingequation (4) (Demassue, 1994):

$$LCI = \frac{consumed \;\; volume}{network \;\; lengt\,h \times 365} \quad \text{(Eq. 4)}$$

- **Linearloss index**

The linearloss index is a performance indicator for drinking water distribution networks. It isexpressed in cubicmeters per day per kilometer (m^3/day/km). Knowledge of this index makesit possible to bettertarget the sections to beexamined as a priority. It isgiven in thisstudy by equation 5 (Demassue, 1994):

$$LLI = \frac{Volume \;\; released \;\; for \;\; distribution \;\; - consumed \;\; volume}{network \;\; lengt\,h \times 365} \quad \text{(Eq. 5)}$$

2.3.5Evaluation of indicators for the operation of the drinking water supply network

- **Water access rate**

The rate of access to drinking water represents the proportion of the population withregularaccess to a water source of sufficientquality to meettheir basic needs. It is the ratio betweenthe population with effective access to drinking water and the total population of the area. It isexpressedaccording to equation 6 (MINHAS, 2021):

$$Ta = \frac{NNumber \;\; of \;\; subscribers \;\; * house\,hold \;\; size}{Total \; population \;\; covered} \times 100 \quad \text{(Eq. 6)}$$

- **Cancellation rate**

This indicatorrefers to the proportion of householdsthatvoluntarily and formallydisconnectfrom the distribution network. This isgenerally due to economicfactors (financialinsecurity, prohibitive cost of service) or technicalfactors (recurring service failures). This indicatorreflectsbothsupplyfailures and inequalities in access to an essential resource. It is the ratio between the number of subscriberswho have terminatedtheir service and the number of actual connections in the locality in question. In thisstudy, itisgiven by the following formula, equation 7 (MINHAS, 2021):

$$\mathrm{Cr} = \frac{\text{Number of subscribers canceled}}{\text{Total number of actual connections}} \times 100 \qquad \text{(Eq. 7)}$$

- **Desert rate**

The capacity of the water supply system to providesafedrinking water to the population ismeasured by thisindicator. The ratio between the volume of safedrinking water supplied to the inhabitants of a givenlocality and theirsafedrinking water needsis a key indicator of water supplyefficiency. The termisdefined in equation 8 (MINHAS, 2021):

$$\mathrm{Dr} = \frac{\text{Supplied volume}}{\text{Demand}} \times 100 \qquad \text{(Eq. 8)}$$

In the domain of urbanhydraulics, the volume of water suppliedisdetermined as the differencebetweenaveragedaily production (m^3/day) and averageloss (m^3/day).

- **Number of hours of service or number of hours of coverage of the demand**

This indicator quantifies the mean service time, or the mean duration of supply over a 24-hour period. This calculationisderivedfromequation 9 (MINHAS, 2021):

$$Nh = \frac{Supply}{Demand} * 24 \qquad \text{(Eq. 9)}$$

- **Production deficit rate**

The production deficit rate measures the proportion of the production deficit in relation to the overalldrinking water demand of the population in the area underconsideration. It is the ratio between the production deficit and the total demand of the localityunderconsideration. It isgiven in thisstudy by equation 10 (MINHAS, 2021):

$$\mathrm{PDr} = \frac{\text{Total demand } (m^3/\mathrm{d}) - \text{current production } (m^3/\mathrm{d})}{\text{Total demand } (m^3/\mathrm{day})} \times 100 \qquad \text{(Eq. 10)}$$

- Measurement of pressures on the drinking water supply network

The portable flow meter (Sewerin) and pressure sensors (Cello 4s) wereutilized to assess flow rates and pressure at sectormeters and at specificnodeswithin the sub-district network of the study area (see Figure 2).

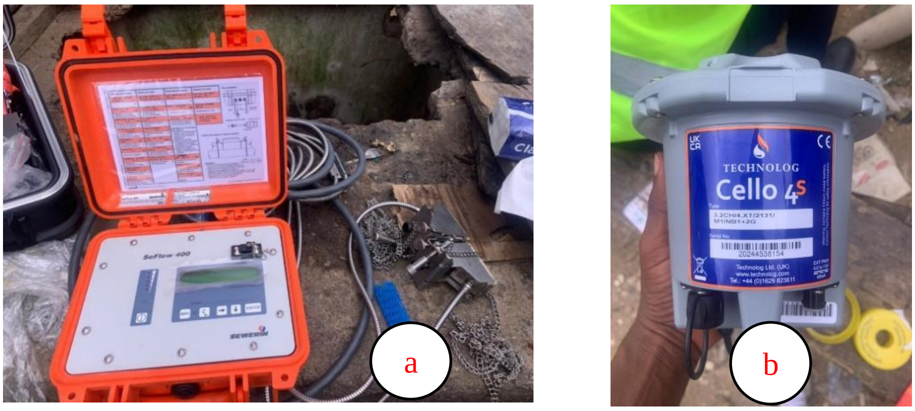

Figure 2.Field equipment

a) The Flowmeter (Cewerin) ; **b)**Pressure sensors (Cello 4^S)

3. RESULTSAND DISCUSSION

3.1. Density of subscribers in Yopougon-Koweït

- **Evolution of the number of subscribers**

The primary source of drinking water for the population of Yopougon-Kuwait is the public drinking water network (SODECI). Initiatives such as the URBIS project, the Emergency Urban Infrastructure Project, the Abidjan RestructuredNeighborhoodsDevelopment Project, and the Drinking Water for All Project, which have been implemented in the neighborhoodsince 2006, have contributed to enhancingaccess to drinking water for the population. The number of subscribersincreasedfrom 18 in 2006 to 5,438 in 2022 (see Table I). From 2010 to 2022, the subscription rate in the Yopougon-Koweït neighborhoodexhibited a substantialincrease of 53%.

Table I. Evolution of the number of subscribers in Yopougon-Koweït (Abidjan District), Côte d'Ivoire)

Years	2006	2010	2015	2022
Subscribers	18	2863	2588	5483

- **Subscriberdensityanalysis**

Subscriberdensityis indicative of the number of householdsconnected to RéPEP per unit of area. The number of subscribers per kilometerincreasedfrom 154 in 2010 to 167 in 2022, but decreased to 139 in 2015 (see Table II).

Table II. Evolutionof thesubscriber density in Yopougon-Koweït

Years / Indicators	2010	2015	2022
Subscriberdensity(subscriber/km)	154	139	167

As illustrated in Figure 3, the Johannesburg sub-neighbourhood (1,840 subscribers) exhibits the highest concentration of subscribers. The Sante extension sub-neighbourhood, with a subscriber base of 975, isnoteworthy as the second mostconnected area. The Konan Ferrand (767 subscribers), Gouro (714 subscribers), and Koweït(710 subscribers) subneighbourhooddemonstratemoderatecoverage. The Ravin area (540 subscribers) appears to be the least connected.

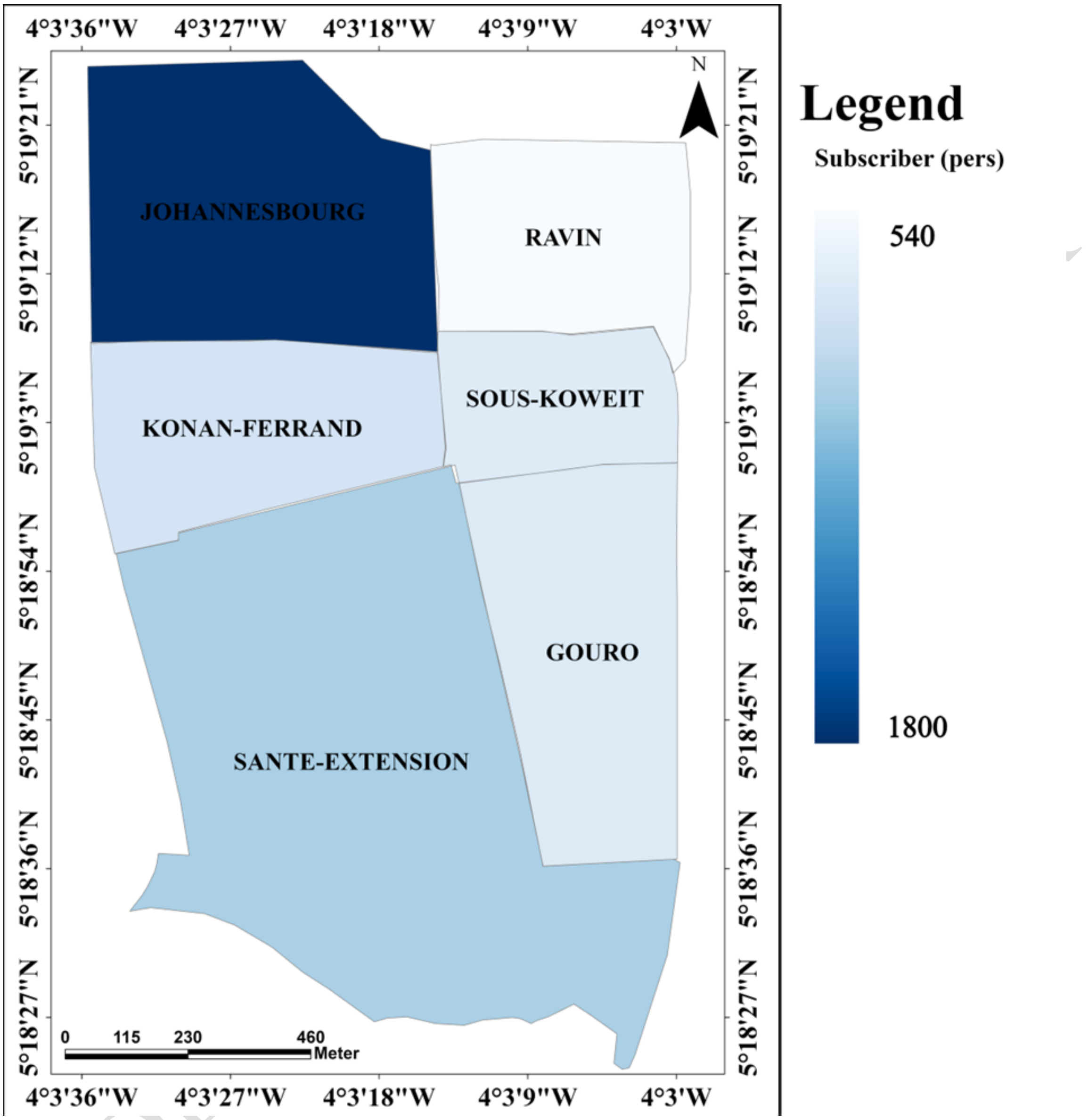

Figure 3. Density map of subscribers in Yopougon-Koweït

3.2. Household water consumption of the population

Water consumption in the Yopougon-Koweït neighborhood, based on SODECI data from 2010, is 300,957 m^3/year and 542,259 m^3/yearin 2022. The number of subscribersbilled rose from 2,863 in 2010 to 5,483 in 2022. The averagehousehold size remainsunchanged and isestimated at six people per subscriber. This leads to a specificconsumption of 48 L/day/residentin 2010, compared to 55 L/day/residentin 2015 and 45 L/day/residentin 2022 (Table III). In addition, the averagedomestic water consumption of a subscriber in the Yopougon-Koweït neighborhoodis 247 L/day/subscriberin 2010, compared to 330 L/day/subscriberin 2015 and 271 L/day/subscriberin 2022.

Table III. Evolution of billed water volumes and specificconsumption

Years	2010	2015	2022
Volume of water consumed (m^3/year)	300 957	311 723	542 259
Specificconsumption (L/day/resident)	48	55	45

Figure 4 shows that the Johannesburg sub-neighborhood (202,760 m^3) stands out clearly as the area with the highest water consumption. The Konan Ferrand (89,720 m^3), Koweït (68,996 m^3), Ravin (65,772 m^3), and Gouro (67,958 m^3) sub-neighborhoods have moderateconsumptionlevels. The Sante extension sub-neighborhood (70,099 m^3) isslightlyabove the lowerthreshold, but remainswithin a lower range than the others.

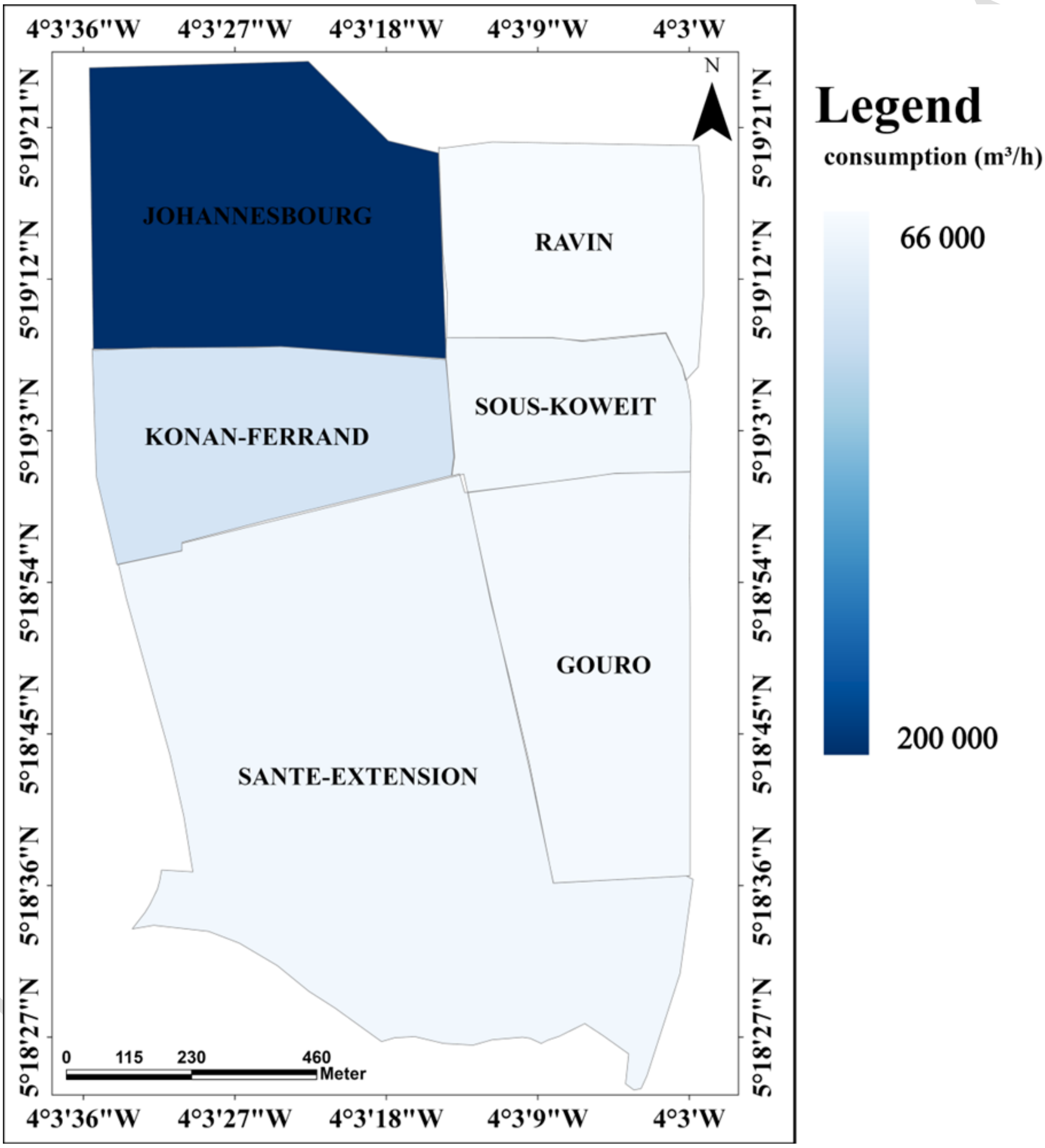

Figure 4. Consumptiondensitymap of Yopougon-Koweït

- **Evolutionof thespecificconsumption**

Water consumption in the study area, based on SODECI data from 2010, is 300,957 m^3/year and 542,259 m^3/yearin 2022. The number of subscribersbilledwas 2,863 in 2010 and 5,483 in 2022. The averagehousehold size remainsunchanged and isestimated at 6 people per subscriber. This leads to a specificconsumption of 48 L/day/residentin 2010, compared to 55 L/day/residentin 2015 and 45 L/day/residentin 2022 (Table IV). In addition, the averagedomestic water consumption of a subscriber in Yopougon-Koweït is 247 liters per day (L/day/subscriber) in 2010, compared to 330 L/day/subscriberin 2015 and 271 L/day/subscriberin 2022.

Table IV. Evolution of billed water volumes and specificconsumption

Years	2010	2015	2022
Volume of water consumed (m^3/year)	300 957	311 723	542 259
Specificconsumption (L/day/hbt)	48	55	45

3.3 Analysis of water losses

The estimate of water lossesbased on SODECI consumption data indicatesthat water lossesincreasedfrom 706 m^3/dayin 2010 to 854 m^3/dayin 2015 and to 1,486 m^3/dayin 2022, representing a loss of 71%, 65%, and 38% of averagedaily production, respectively (Table V). Between 2010 and 2022, the averagedaily production decreased by 10% per year/dayin 2022, representinglosses of 71%, 65%, and 38% of averagedaily production, respectively (Table V). Between 2010 and 2022, therewas a significantreduction in the loss rate in the Yopougon-Koweït neighborhood of 33%.

Table V. Assessment of water lossesfrom 2010 to 2022

Years	2010	2015	2022
Volume of water consumed (m^3/year)	888	854	1540
Water volume produced (m^3/day)	2450	2440	2406
Water loss (m^3/day)	706	854	1486
Loss rate (%)	71%	65%	38%

3.4 Network performance parameteranalysis

As illustrated in Table VI, there has been an enhancement in the primarytechnicalefficiency of the network from 2010 to 2022. The percentage increasedfrom 32% to 62%. However, thisefficiencyfalls short of the established standard of 80%. The linearconsumption index exhibitedstability, maintaining an average of 45 m^3/day/km. The linearloss index exhibited a substantialimprovement, decreasingfrom 88 m^3/day/km in 2010 to 28 m^3/day/km in 2022. However, this value is indicative of the substandard condition of the RéPEP.

Table II. Performance indicators for the RéPEP in Yopougon-Koweït

Years / Indicators	2010	2015	2022
Technicalefficiency (%)	32	35	62
Linearconsumption index (m^3/day/km)	44	46	45
Linearloss index (m^3/day/km)	88	85	28

3.5 Drinking water supply network operating indicators

Table VII presents the operating indicators for the RéPEP in the Yopougon-Koweït neighborhood. The rate of access to drinking water for the populations of Yopougon-Koweït has improvedsignificantly. It rose from 47% in 2010 to 68% in 2022, with a significantdecline of 39% in 2015. The service rate rose from 23% in 2015 to 31% in 2022. These rates reflect the investments made in the urban water sector. The cancellation rate in 2010 and 2022 isvirtuallyzero. In contrast, this rate rose by 10% in 2015. The number of hours of service isaround 13 hours and remainedrelatively stable between 2010 and 2015. This numberdeclined to 10 hoursin 2022. In addition, the production deficit rate increased over the three (03) years. It rose from 32% in 2010 to 50% in 2022. This rate reveals a gap between the increase in production and the expansion of water service.

Table III :RéPEP operating indicators in Yopougon-Koweït

Years / Indicators	2010	2015	2022
Access rate (%)	47	39	68
Cancelled rates (%)	0,3	10	0
Desert rate (%)	23	22	31
Number of hours of desert(H)	13	14	10
Production deficit rate (%)	32	38	50

- **Analysis of pressures on the Yopougon Kuwait network**

The Yopougon-Kuwait network experiencessignificant pressure fluctuations (Figure 5). Thesevaryfrom -1.25 mCE to 32.1 mCE and follow a daily cycle marked by twopeaks (2 a.m. to 4 a.m. and 12 p.m. to 2 p.m.) and twolowperiods (7 a.m. to 9 a.m. and 4 p.m. to 7 p.m.). The distribution network shows significant spatial heterogeneity in pressure. It can becategorizedintothree distinct classes: (i) high-pressure areas, (ii) intermediate-pressure areas, and (iii) low-pressure areas.

The Johannesburg sub-neighborhoodis the area under the most pressure and has the highest pressures in the network. These pressures range from 12 to 32.1 mCE at night (9 p.m. to 5 a.m.) and from 8 to 15 mCEduring the day (6 a.m. to 8 p.m.). The Ravin and Konan Ferrand sub-neighborhoods are areas of intermediate pressure. Pressures in Ravin varyfrom 10 to 25 mCE at night and from 5 to 9 mCEduring the day. In the Konan Ferrand sub-neighborhoods, pressures varyfrom 5 to 21 mCE at night and drop to a range of 2 to 7 mCEduring the day. The Sous-Koweït, Gouro, and Sante Extension (Sikasso) sub-neighborhoods are low-pressure areas. In the Sous-Koweït area, the pressure, whichisalreadylow at night (1-7 mCE), drops to a verylowlevelduring the day (0-1 mCE). The situation iseven more worrying in the Gouro and Sikasso sub-neighborhoods, which have virtuallyzero pressure both at night and during the day.

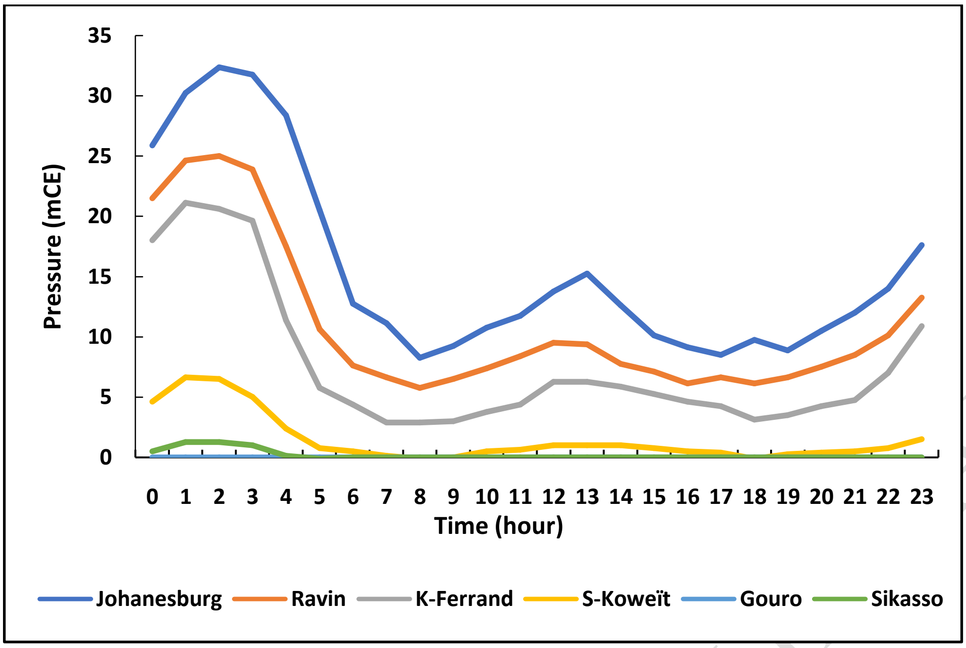

Figure 5. Pressure variations on the Yopougon-Koweït

3.1 Discussion

The study shows exponentialgrowth in the number of subscribers in Yopougon-Koweït. This number rose from 18 in 2006 to 5,483 in 2022. This increasereflects the impact of government actions to improveaccess to drinking water for the population with a view to achieving SDG 6. Indeed, the rate of access to urban water supply rose from 80.7% in 2015 to 84% in 2020 (PND 2021). Conversely, specificconsumptionfellfrom 48 L/day/residentin 2010 to 45 L/day/residentin 2022.This decline has gone from 64.2 L/day/resident (Thompson et al., 2002) to 50-55 L/day/residentin 2023, due to demographic pressure and recurringshortages. Furthermore, this value islowerthan the averageconsumption ratio set at 100 L/day/resident in the autonomous district of Abidjan (ONEP, 2020). However, this ratio masksdisparitiesbetweendifferent population groups' standards of living. Householddailydrinking water consumption varies according to householdincome. It is 132 liters per person for high-incomehouseholds and 88 liters per person for low-incomehouseholds (Ta bi Boti et al., 2019).

In addition, the network'sprimarytechnicalefficiencyimprovedbetween 2010 and 2022, risingfrom 32% to 62%. The linearloss index alsoimprovedsignificantly, from 88 m3/day/km in 2010 to 28 m^3/day/km in 2022. Subscriberdensityincreasedsignificantly, from 154 subscribers/km in 2010 to 167 subscribers/km in 2022. This improvementcouldbelinked to the actions undertaken by SODECI in 2015 in the district of Abidjan. These actions consisted of pressure management, sectorization, active leakdetection, replacement of oldmeters, modernization of metering, and the fightagainstfraud (N'cho, 2021).However, the study highlights the poor performance parameters of the Yopougon-Kuwait network, withefficiencybelow the standard set at 80% for good efficiencyaccording to Blarel and Merzouk (2005). The sameistrue for the linearloss index, for which the recommended standard islessthan 15 m3/day/km (ANBT, 2020). This poor network performance couldbeexplained by itsage (17 years on average) (Kleiner et al., 2001). Furthermore, according to Alegre et al. (2022), the aging of pipes significantlyreduces the hydraulic performance of the RéPEP by altering the roughness of the walls.

Access to drinking water in Yopougon-Kuwait has improvedsignificantly. It rose from 47% in 2010 to 68% in 2022, despite a significant drop of 39% observedin 2015. This significantdecline in access to drinking water wascaused by the consequences of the 2011 politicalcrisis. This situation severelycompromised water infrastructure and water sectorgovernance in Côte d'Ivoire (Kouadio et al., 2017;AfDB, 2016). In addition, the service rate rose from 23% in 2015 to 31% in 2022. Theseaccess and service rates are in line with the targets set by the National Water Investment Program (PNIH) for the period 2010-2022. This program aims to improvesustainableaccess to drinking water in urban and peri-urban areas in Côte d'Ivoire (MINHAS, 2022). The cancellation rate remainedvirtuallyzeroin 2010 and 2022. However, this rate increased by 10% in 2015.This couldbeexplained by a crisis of confidence and/or irregular service linked to the discontinuity of SODECI's water service, leading to cancellations (Grafton et al., 2019). The number of hours of water service has fallenfrom 13 hoursin 2010 to 10 hoursin 2022. The production deficit rate has increasedfrom 32% in 2010 to 50% in 2022. Theseresultsattest to a structural gap between the population's water needs and the volumes of water distributed by the network. Indeed, recentstudiesconfirmthat the reduction in service hours and the increase in the production deficit rate are the result of a mismatchbetweengrowingdemand and actual distribution capacity (AfDB, 2020)

The pressure profile of the Yopougon-Kuwait network ischaracterized by extreme amplitude (-1.25 to 32.1 mCE) and a daily cycle contrastingpeaks (nighttime/midday) and troughs (morning/evening). These variations reflecttypicalbehavior in water distribution networks under the influence of socio-economicdemand (Alvisi and Franchini, 2018). Indeed, pressure peaks (night and midday) correspond to periods of lowdemand. Conversely, pressure troughs (morning and evening) are caused by peaks in domesticconsumption (Buchberger et al., 2003). These observations are consistent withthose of Haque and Rahman (2016), who highlight extreme pressure fluctuations, withcritical drops at peak times, particularly in the morning and evening.This studyalso highlights thaturbandensityexacerbates the problem and createsmarked spatial disparitiesbetween the center and the peripheries. Furthermore, the high spatial heterogeneity of stratified pressures in areas of high pressure (Johannesburg), intermediate pressure (Ravin, Konan Ferrand), and low pressure (Sous-Koweït, Gouro, Sante extension (Sikasso)) indicatesprofoundinequalities in access to drinking water services.Indeed, stratification of networks into classes according to pressure (high, medium, low) iscommon in poorlybalanced networks, as observed in Nairobi (Kenya) and Dhaka (Bangladesh) (Mutiku et al., 2014;Haque and Rahman, 2016). However, the virtuallyzero pressures observed in the networks in the Gouro and Sante Extension (Sikasso) areas reflect a hydraulicimbalance. According to Jadhav et al. (2016), persistent near-zero pressures in the Mumbai and Karachi networks reveal not only a hydraulicimbalance but also an acute healthrisk. Indeed, the negative pressure measured in Sante Extension (Sikasso) (-1.25 mCE) is a criticalindicator of healthrisk.

CONCLUSION

Performance analysis shows poorhydraulic performance of the network, particularly in terms of efficiency and water losses. Despiteincreasedaccess to drinking water and subscriberdensity, network performance remainsinadequate. Indeed, the decline in specificconsumption, combinedwith a reduction in service hours and a growing production deficit, reveals a persistent mismatchbetweendemand and distribution capacity.

The Yopougon-Kuwait network ischaracterized by a pressure profile fluctuatingbetween -1.25 and 32.1 mCEwithpeaks (nighttime/midday) and lowperiods (morning/evening). In addition, its high spatial heterogeneity of stratified pressures in areas of high pressure (Johannesburg), intermediate pressures (Ravin, Konan Ferrand), and low pressures (Sous-Kuwait, Gouro, Sante extension (Sikasso)) indicatesprofoundinequalities in access to drinking water services.

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