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Local Environment

The International Journal of Justice and Sustainability

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/cloe20

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To cite this article: Godfred Amankwaa, Kwaku Abrefa Busia, Pascal Agbadi, Henry O. Duah & Francis Arthur-Holmes (2024) Access heterogeneities and collection time inequalities of drinking water sources in Ghana: implications for water and development policy, Local Environment, 29:3, 263-278, DOI: 10.1080/13549839.2024.2306596

To link to this article: https://doi.org/10.1080/13549839.2024.2306596

Published online: 02 Feb 2024.

LOCAL ENVIRONMENT
2024, VOL. 29, NO. 3, 263–278
https://doi.org/10.1080/13549839.2024.2306596

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Access heterogeneities and collection time inequalities of drinking water sources in Ghana: implications for water and development policy

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ABSTRACT

Time poverty remains a critical issue for water access across the globe. However, research on the time spent for water collection and the factors associated with collection time inequalities and access heterogeneities is limited, especially in sub-Saharan Africa. Drawing on the 2014 Ghana's Demographic and Health Survey (DHS) data, and statistical and spatial analysis, we apply the concept of "everydayness" of water collection time poverty to examine the factors associated with water collection time inequalities and access heterogeneities of drinking water sources in Ghana. Our analysis shows that 8.6% of households face drinking water collection time poverty and this is prevalent and significant across different socio-economic groups and geographies. The observed geographical heterogeneity and collection time inequality in drinking water sources in this paper adds to the literature in terms of variation in household water insecurity across time and space. The water policy implications of these findings are discussed, and we highlight strategies to rethink drinking water security in the Global South.

ARTICLE HISTORY
Received 2 July 2023
Accepted 8 January 2024

KEYWORDS
Drinking water source; collection time poverty; Ghana; inequalities; water access

Introduction

Though the United Nations' Sustainable Development Goal for water and sanitation, calls for universal and equitable access to safe and affordable drinking water by 2030, the first step towards providing everyone with a basic service within a 30-minute round trip remains a challenge (Hutton and Varughese 2016; UNICEF/WHO 2019). For instance, 263 million people spend 30 minutes a day collecting water (World Bank 2020). Estimates show that the number of households using limited services with a round trip for water collection exceeding 30 minutes was around 135 million, which more than doubled compared to previous estimates (UNICEF/WHO 2019). The burden of fetching water remains widespread where water on premises is uncommon and is likely to threaten water security (Cassivi et al. 2019; Graham, Hirai, and Kim 2016) as well as sustain water poverty among marginalised groups in society (Harris et al. 2017).

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In most parts of the world, water source location is not only likely to have an impact on water accessibility, but the volume of water households collect and use for their daily activities (Howard et al. 2020). Thus, the provision of water sources in proximity to households would likely facilitate the collection of sufficient water for various usage of water that would improve domestic and personal hygiene. Even among households with on-premises connection, access to water is highly differentiated. Previous research indicates that the global burden of poor access to safe drinking water falls primarily on the poorest of the poor (Phansalkar 2007). These inequalities have an important bearing on human development because of their association with education, poverty and income (Gambe 2019; UNDP 2006). Besides, water access challenges and collection time issues related to the proximity of water sources is noted to exacerbate gender inequalities (Harris et al. 2017). This is because women and girls disproportionately spend most of their days collecting water for their households, especially in rural areas, which limits their productive time spent towards their income-generating activities (Gambe 2019; UN 2015).

In the context of Ghana, the government has made extensive efforts to ensure universal access to safe drinking water and improved services, yet water collection times are reported to be high (Dongzagla, Nunbogu, and Fielmua 2020). Data from UNICEF and WHO Joint Monitoring Programme (JMP) for Water Supply and Sanitation shows that 81% of the Ghanaian population have access to basic water services (WHO & UNICEF 2021). However, this indicator does not reflect the full definition of water access such as time spent, physical availability and distance to the sources. Also, physical accessibility to water points or facilities does not guarantee access (Amankwaa and Ampratwum 2020). For instance, over five million Ghanaians do not have access to safe drinking water and even among those with access to basic water, supply is often intermittent and unreliable. Also, the increasing failure and breakdown of existing water infrastructure and pollution of water resources due to illegal mining activities have increased the brunt of water inequalities and long collection times across the country, with negative impacts on health, education and general productivity (Arthur-Holmes et al. 2022; Yeboah 2008). It is estimated that on average, women and girls in Ghana spend about 4.5 hours per week drawing and carrying water (Archer 2005, 25).

At present, existing literature on the water and development nexus have examined the factors associated with water source selection and access to improved water sources (Adams, Boateng, and Amoyaw 2016; Armah et al. 2018), everyday practices and negotiations of water access in underserved areas and the gendered dimensions of water access (Harris et al. 2017; Jeil, Abass, and Ganle 2020; Peloso and Morinville 2014). However, gaps remain in understanding how distance to water sources and the types of sources available affect time spent in water collection. Also, the spatio-temporal scale/dynamics of water access and identification of areas and segments of the population that have challenges concerning time spent to access water in Ghana needs further exploration. Besides, a critique of the current literature stems from the restricted geographical focus on a few areas, mainly urban and peri-urban areas (see for instance, Braimah, Nti, and Amponsah 2018; Harris et al. 2017; Peloso and Morinville 2014). As such, despite highlighting the socio-cultural dynamics affecting water source selection as well as water access negotiations and challenges, the generalisability of these findings is limited for understanding the (regional) spatial disparities concerning water access, collection time inequalities and uneven drinking water sources. Consequently, it becomes problematic to use such predominant qualitative studies to inform water policy frameworks and to address regional disparities in water-related infrastructure in the country.

In this study, we draw on the 2014 Demographic and Health Survey (DHS) data on Ghana to examine the prevalence and factors associated with drinking water collection time and inequalities. This paper is concerned with physical proximity of a drinking water source to where individuals and households live, and the amount of time people spend collecting water. Secondly, it also studies how the time spent on water collection varies across different socio-economic groups and geographies, such as household wealth and marital status.

The findings of this study have several contributions. It adds to scholarship on water and development, specifically on water collection poverty and inequality in the Global South. Also, it provides

information for policy direction related to monitoring access to water in Ghana which is poorly addressed. Lastly, given that the study relies on a nationally representative sample based on data from the 2014 DHS, it will contribute to policy frameworks for Ghana's ambitious vision of "ensuring a 100% safe water coverage by the year 2025" (MWRWH 2007). It will also help in ongoing attempts to update the 2007 National Water Policy and related strategies and plans to align with the SDG standards and national aspirations. Linked to this contribution, follows from the study's use of spatial mapping visualisations to report the prevalence of household time spent on water collection and water access differentials.

The everydayness of water fetching and collection time poverty

In this section, we discuss the literature on the "everydayness" of water fetching and collection time poverty.

Water collection time poverty refers to the repeated and excessive time-distance constraints involved in accessing water for individuals and households which often reduces time spent for other productive activities. Individuals who are time poor in terms of water collection tend to spend enormous amount of time fetching water for their households leaving relatively less time for engaging in other important roles such as work and school (Abrefa Busia 2022; Archer 2005). Time poverty has long been recognised as a constraint to development, especially among women who have to spend long hours in collecting water for their households due in part to lack of basic water infrastructure services and investments in sustainable water systems (Cassivi, Waygood, and Dorea 2016; 2018; Wodon and Blackden 2006). Over a billion people collect water from sources outside of their home (WHO/UNICEF 2017), which often requires travelling significant distances and queuing for long periods. To this end, collecting water is often situated in the everyday life of individuals whereby people spend time and efforts towards accessing water.

Conceptually, we define the everydayness of water collection as the processes, practices, lived experiences and time–space dimensions of accessing and securing water for household needs which usually occur on a daily basis. The everydayness of accessing water for various household needs is an age-old phenomenon. As a basic necessity, water remains an everyday essential resource utilised by individuals, families and communities across space and time. However, accessing water comes with myriad of challenges for people of various socio-economic backgrounds depending on the proximity to water sources and the time spent to collect water. Thus, the concept of everydayness of water fetching and (water) collection provides a basis for understanding the prevailing heterogeneities and inequalities of water access.

By "everyday", we emphasise the constant and continuous usage of individuals' time for collecting water and the distance they have to go to get water for themselves and their families. This is because, as a basic human need and a human right (UNICEF & WHO 2019), access to water is seen as an indispensable aspect of human life that individuals cannot do without on a daily basis. While other studies have pointed to the "everyday negotiations" of water access and its linkages with informal water providers (Harris et al. 2017) and everyday practices and governance of water access beyond piped networks within urban areas (Truelove 2019), our focus on everyday time spent for water collection highlights the time deficit or gain dimensions of water access relative to the location of water sources. Thus, we argue that depending on the proximity of water sources to individuals and households, lesser or greater time is spent for fetching water. Consequently, this may result in water collection poverty due to length of time used, which is likely to affect time for other productive endeavours. It is in this light, that emphasis on gendered water poverty (Gambe 2019; Harris et al. 2017), for instance, cannot be under-emphasised given the disproportionate amount of time women spend on collecting water and how this situation may entrap them in poverty. As long as people use water, it is imperative that they re-stock more for their household needs on a regular basis. However, with water scarcity and access issues, the everyday collection of water may have different meanings and realities for different people depending on their

socio-economic status, geographical location, household wealth, sex and other environmental conditions like climate, which affect the everydayness of getting water.

Aside from the actual distance between the source of water and point of use, socio-economic, cultural, behavioural and institutional factors may have an impact on the water source that households choose to access, which in turn influences "who fetches water", who carries the water and the quantity and the quality of water (Amankwaa, Heeks, and Browne 2022; Cassivi et al. 2018; Graham, Hirai, and Kim 2016; Smiley and Stoler 2020). Apart from women, studies also indicate that children in 25 sub-Saharan African countries spend an estimated four million hours every day fetching water, which keeps them away from school (UNICEF & WHO 2012).

Water accessibility (mostly in terms of proximity, water fetching and collection time in our study) have diverse implications across different socio-economic, demographic and structural groups. Data suggest that water-related infrastructure investments could free up time spent on water collection to the equivalent of more than half a million new full-time jobs for women if converted into paid employment (Fontana and Natali 2008). Unlike previous studies that have focused on improved water sources, this study examines the duration individuals and households use in their everyday collection of water as well as the heterogeneities and inequalities that exist in household water access in Ghana.

Research data and methods

Data sources

This study uses the cross-sectional data from the 2014 Ghana Demographic and Health Survey. The survey used a two-stage sampling design. The first stage consisted of the random selection of primary sampling units or clusters. Clusters consisted of enumeration areas that were delineated during the 2010 Ghana Population and Housing Census. For each cluster that was randomly selected in the first stage, there was systematic selection of households during the second stage. Cluster selection was stratified by place of residence to account for rural-urban variance in the population. Cumulatively, 427 clusters were selected (216 urban and 211 rural clusters). Averagely, thirty (30) households were selected from each sampled cluster resulting in a total of 12,831 selected households, and 12,010 were habited. During the enumeration, 11,835 heads successfully responded to the questionnaire, resulting in a response rate of 99% (GSS 2015). For each household, data on access to water and time spent to fetch water was obtained along with other socio-demographic data of the household. The details of the sampling and data collection procedures have been described in the 2014 GDHS report (GSS 2015). One hundred and eighteen cases with missing records on the study variables were excluded from the analyses. In total, 11,717 households were involved in the final analysis.

Measures

Outcome variable

The outcome variable under investigation was the time (minutes) it took for household to fetch/obtain water for domestic use mainly drinking purposes. We are interested in household or domestic water collection because the quality and quantity of household water, and the time devoted to water collection, have wide implications on the health and wellbeing of individuals and households such as limiting productivity and forcing out the rewarding uses of time of water "*fetchers*". The outcome variable was derived from the question: "How long does it take to go there [drinking water source], get water, and come back?". The outcome variable was originally coded as a continuous variable (minutes). Based on JMP classifications of round-trip collecting time for water, we recoded this into a binary variable: [0] Households that spent less than or equal to 30 minutes and [1] households that spent more than 30 minutes to fetch water or collect water.

It should be noted that for estimating the time spent collecting water, the DHS questions do not determine whether households are spending this time waiting for water (e.g. queuing at a water point) or walking, however, as demonstrated in the JMP ladder, for people or households to meet the criteria for a safely managed drinking water service, people must use an improved source which is accessible on premises or basic drinking water services and collection time should not be more than 30 minutes for a roundtrip including queuing. Since the goal is provide safely managed drinking water for everyone, spending more than 30 minutes to access water is an issue of concern for household water security.

Explanatory variables

Explanatory variables included age, education, sex and marital status of household heads (HH), household wealth index, source of drinking water, place of residence and region of residence. All variables were used as they were in the original dataset, except for source of drinking water and age of HH. Source of drinking water was recoded as improved or unimproved based on JMPs classifications: "improved source" = 1 to include water piped into its dwelling, water piped to a yard/plot, a public tap/standpipe, a tube well/borehole, a protected dug well, a protected spring, rainwater, bottled water, or sachet water, and "unimproved source" = 2 to include unprotected dug well, an unprotected spring, a tanker truck/cart with a small tank, or surface water. Age of HH was recoded from a continuous variable into categories of 15–29 years, 30–44 years, 45–59 years and 60+ years for easier comparison of age groups. Socioeconomic status was assessed using the household wealth index, calculated from household assets like TV, radio, vehicles, land and animals. Factor analysis assigned weights to each asset, ranking households into quintiles based on cumulative scores for categorisation into poorest, poorer, middle, richer and richest (see Rutstein and Johnson 2004). Details of explanatory variables can be found in Table 1.

Statistical and spatial analysis

Data analysis involved, univariate, bivariate and multivariate analysis. All analyses were done accounting for sample design. Bivariate analysis included chi-square test for independence to identify factors associated with the outcome under investigation. Binary logistic regression was performed separately for each predictor and the outcome, and the crude estimates of the odds ratios (OR) were reported. For the multivariate analysis, a multiple logistic regression analysis was also performed to report adjusted OR estimates. The crude and adjusted OR estimates were obtained after setting our analysis in the complex sample design mode using the "svyset" function in Stata to account for sample design, weighting and stratification. This ensured accurate estimations of confidence intervals and standard errors. Thus, the crude and adjusted OR estimates were used to explain the relationship between the outcome and the explanatory variables.

Also, we generated surface maps to provide spatial mapping visualisation for the study using Quantum Geographic Information Systems (QGIS) software and prevR Package in R. The national and sub-national shapefile with delineated regions was obtained from the DHS programme. Weighted prevalence of the outcome was used to produce the regional surface map in QGIS. In addition, we provided a sub-regional visualisation of the outcome using the prevR Package in the R freeware version 4.0.3. The prevR package was built to produce spatial maps in R with the DHS data (Larmarange et al. 2011). Other adjunct R packages included *ggplot, maptools* and foreign packages. The primary surface was a weighted estimate of the proportion of households who spent more than 30 minutes to fetch water. This was produced with a parameter $N = [321]$, an estimated value chosen with the "Noptim" function in the PrevR package (Larmarange et al. 2011). The "*N*" value was dependent on the observed national burden, the number of households who spent more than 30 minutes to fetch water and the number of clusters. We estimated the weighted prevalence of households that spent more than 30 minutes to fetch water prior to generating the subregional surface maps.

Table 1. Summary statistics of study variables.

Study variables	Column % Total *n* (%)	Drinking water collection time (row %) ≤30 minutes *n* (%)	>30 minutes *n* (%)	*p*-value
	11,717 (100%)	10,712 (91.4%)	1004 (8.6%)	
Gender of HH				0.14
Male	7752 (66.2)	91.2	8.8	
Female	3965 (33.8)	92.0	8.0	
Age of HH				0.001
15–29 years	2311 (19.7)	93.6	6.4	
30–44 years	4222 (36.0)	92.0	8.0	
45–59 years	2971 (25.4)	90.0	10.0	
60+ years	2213 (18.9)	90.1	9.9	
Education of HH				
None	2576 (22.0)	84.1	15.9	
Primary	1605 (13.7)	87.6	12.4	
Secondary	4576 (39.1)	93.2	6.8	
Post-secondary	2959 (25.3)			
Marital status of HH				0.001
Never married	1909 (16.3)	95.9	4.1	
Currently married	7150 (61.0)	90.1	9.9	
Formerly married	2653 (22.7)	91.7	8.3	
Household Wealth				0.001
Poorest	1580 (13.5)	77.9	22.1	
Poorer	2203 (18.8)	84.0	16.0	
Middle	2632 (22.5)	91.8	8.2	
Richer	2660 (22.7)	97.3	2.7	
Richest	2642 (22.5)	99.5	0.5	
Drinking water source				0.001
Improved	10526 (89.8)	93.2	6.8	
Unimproved	1191 (10.2)	76.2	23.8	
Place of residence				0.001
Urban	6413 (54.7)	96.5	3.5	
Rural	5304 (45.3)	85.2	14.8	
Region of residence				0.001
Western	1292 (11.0)	89.0	11.0	
Central	1176 (10.0)	96.7	3.1	
Greater Accra	2418 (20.6)	98.1	1.9	
Volta	1002 (8.6)	81.3	18.7	
Eastern	1234 (10.5)	88.6	11.4	
Ashanti	2212 (18.9)	96.9	3.1	
Brong Ahafo	1014 (8.7)	91.2	8.8	
Northern	731 (6.2)	68.7	31.3	
Upper East	375 (3.2)	92.5	7.5	
Upper West	264 (2.3)	86.4	13.6	

Results

Sample characteristics

Table 1 shows the characteristics of 11,717 households involved in this analysis. Approximately nine out of hundred Ghanaian households spent more than 30 minutes to collect drinking water (8.6%). Majority of households were headed by males (66.2%), were within the 30–44 years age bracket (39.1%), had secondary education (39.1%), were currently married (61.0%), had access to an improved source of drinking water (89.8%) and were in urban areas (54.7%).

The proportion of male-headed households (8.8%) that spent more than 30 minutes to collect drinking water were slightly more than that of female-headed households (8.0%). A unit increase in the category of the age group a household head belonged to was associated with an increase in the prevalence of water collection time poverty. For instance, the prevalence of households headed by persons with 45–59 years (10%) who spent more than 30 minutes to collect drinking

water was higher than that of other households headed by persons younger than 45 years. Households headed by persons without formal education (15.9%) or with primary level education (12.4%) had the highest prevalence of water collection time poverty. Households with heads that were currently married (9.9%) had higher drinking water collection time poverty prevalence compared to households whose heads were either unmarried (4.1%) or formerly married (8.3%). The prevalence of the poorest (22.1%) and poorer (16.0%) households that had drinking water collection time poverty were more than households with other wealth categories. Households that relied on unimproved water sources recorded the highest prevalence of drinking water collection time poverty (23.8%) compared to households that relied on improved water sources (6.8%). The proportion of rural households (14.8%) that had drinking water collection time poverty were more than that of urban households (3.5%). The proportion of households in the Northern region (31.3%) that had drinking water collection time poverty were the highest among the 10 regions followed by Volta (18.7%) and Upper West (13.6%).

Multivariable regression analysis on factors associated with water collection time in Ghana

Table 2 presents the eight sociodemographic variables fitted in our multivariable regression model to determine the factors associated with household drinking water collection time in Ghana. Gender and education status of household head, household wealth index, source of drinking water, place of residence and region of residence made a statistically significant contribution to the regression model. Female-headed households [AOR = 1.270, 95% CI: 1.042, 1.548] were more likely to spend more than 30 minutes to fetch drinking water compared to male-headed households. Households with currently married heads [AOR = 1.365, 95% CI: 1.027, 1.815] were more likely to spend more than 30 minutes to fetch drinking water compared to households with heads who were never married. Again, households with heads who had no formal education [AOR = 1.549, 95% CI: 1.161, 2.066], attained primary education [AOR = 1.720, 95% CI: 1.260, 2.349] and secondary education [AOR = 1.362, 95% CI: 1.053, 1.762] were more likely to spend more than 30 minutes to fetch drinking water compared to households with heads who attained post-secondary education. Households within the poorest [AOR = 12.99, 95% CI: 5.276, 31.98], poorer [AOR = 13.03, 95% CI: 5.547, 30.63], middle [AOR = 8.578, 95% CI: 3.744, 19.65] and richer wealth category [AOR = 4.075, 95% CI: 1.860, 8.930] were 4 or more times likely to spend more than 30 minutes to fetch drinking water compared to households within the richest category. Also, households with unimproved water sources [AOR = 1.718, 95% CI: 1.251, 2.361] and rural households [AOR = 1.523, 95% CI: 1.084, 2.138] were more likely to spend more than 30 minutes to fetch drinking water compared to households that had access to improved water sources and urban households respectively. In terms of the region of residence, households in the Western [AOR = 2.273, 95% CI: 1.037, 4.982], Volta [AOR = 3.247, 95% CI: 1.491, 7.074] and Northern region [AOR = 4.959, 95% CI: 2.257, 10.89] were more likely to spend more than 30 minutes to fetch drinking water compared to households in the Greater Accra region.

Spatial maps of drinking water collection time poverty in Ghana

Regional distribution in terms of water access prevalence

Among the regions in Ghana, the Greater Accra region had the lowest drinking water collection poverty, with only about two out of hundred households spending more than 30 minutes to collect drinking water. However, Northern region had the highest drinking water access poverty, where about half of all households spent more than 30 minutes to collect drinking water (Figure 1). Also, the spatial interpolated map revealed locational and intra-regional disparities, regarding time spent collecting drinking water. In the Northern region, the north-eastern parts were projected

Table 2. Sociodemographic factors regressed on drinking water collection time.

Study variables	OR [95% CI]	AOR [95% CI]
Gender of household heads		
Male	1	
Female	0.901 [0.752, 1.079]	1.270* [1.042, 1.548]
Age of household heads		
15–29 years	1	1
30–44 years	1.267 [0.980, 1.640]	1.134 [0.844, 1.524]
45–59 years	1.618*** [1.228, 2.131]	1.214 [0.891, 1.654]
60+ years	1.596*** [1.218, 2.090]	1.057 [0.773, 1.446]
Education of household heads		
Post-secondary	1	1
None	6.480*** [4.918, 8.538]	1.549** [1.161, 2.066]
Primary	4.847*** [3.516, 6.683]	1.720***[1.260, 2.349]
Secondary	2.497*** [1.893, 3.294]	1.362* [1.053, 1.762]
Marital status of household heads		
Never married	1	1
Currently married	2.555*** [1.996, 3.271]	1.365* [1.027, 1.815]
Formerly married	2.096*** [1.576, 2.789]	1.052 [0.735, 1.506]
Household Wealth		
Richest	1	1
Poorest	58.10*** [26.01, 129.8]	12.99***[5.276, 31.98]
Poorer	39.01*** [17.55, 86.71]	13.03***[5.547, 30.63]
Middle	18.35*** [8.220, 40.98]	8.578***[3.744, 19.65]
Richer	5.745*** [2.621, 12.59]	4.075***[1.860, 8.930]
Drinking water source		
Improved	1	1
Unimproved	4.266*** [3.058, 5.952]	1.718***[1.251, 2.361]
Place of residence		
Urban	1	1
Rural	4.837*** [3.469, 6.746]	1.523* [1.084, 2.138]
Region of residence		
Greater Accra	1	
Western	6.525*** [2.756, 15.44]	2.273* [1.037, 4.982]
Central	1.821 [0.655, 5.064]	0.569 [0.207, 1.564]
Volta	12.20*** [5.452, 27.30]	3.247** [1.491, 7.074]
Eastern	6.848*** [3.036, 15.45]	1.959 [0.906, 4.237]
Ashanti	1.681 [0.750, 3.766]	0.747 [0.363, 1.538]
Brong Ahafo	5.069*** [2.288, 11.23]	1.408 [0.659, 3.009]
Northern	24.12*** [10.79, 53.90]	4.959***[2.257, 10.89]
Upper East	4.353*** [2.018, 9.387]	0.859 [0.390, 1.890]
Upper West	8.341*** [3.336, 20.85]	1.827 [0.720, 4.641]
Model details		
Number of observations		11,703
Population size		11710.058
Number of strata		20
Number of primary sampling units (PSUs)		427
Design df		407
OR: odds ratio		
AOR: adjusted odds ratio		

Note: Exponentiated coefficients; 95% confidence intervals in brackets.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

to have households having the severest incidence of spending more than 30 minutes to collect drinking water (see Figure 2).

Discussion

With less than a decade to go until 2030, having vital information to help monitor accessibility to water, especially how they are accessed or delivered to the last mile remains crucial. In this study, we analysed existing inequalities in accessing/collecting drinking water from various sources and their associated factors in Ghana. The evidence shows that nine out of hundred Ghanaian

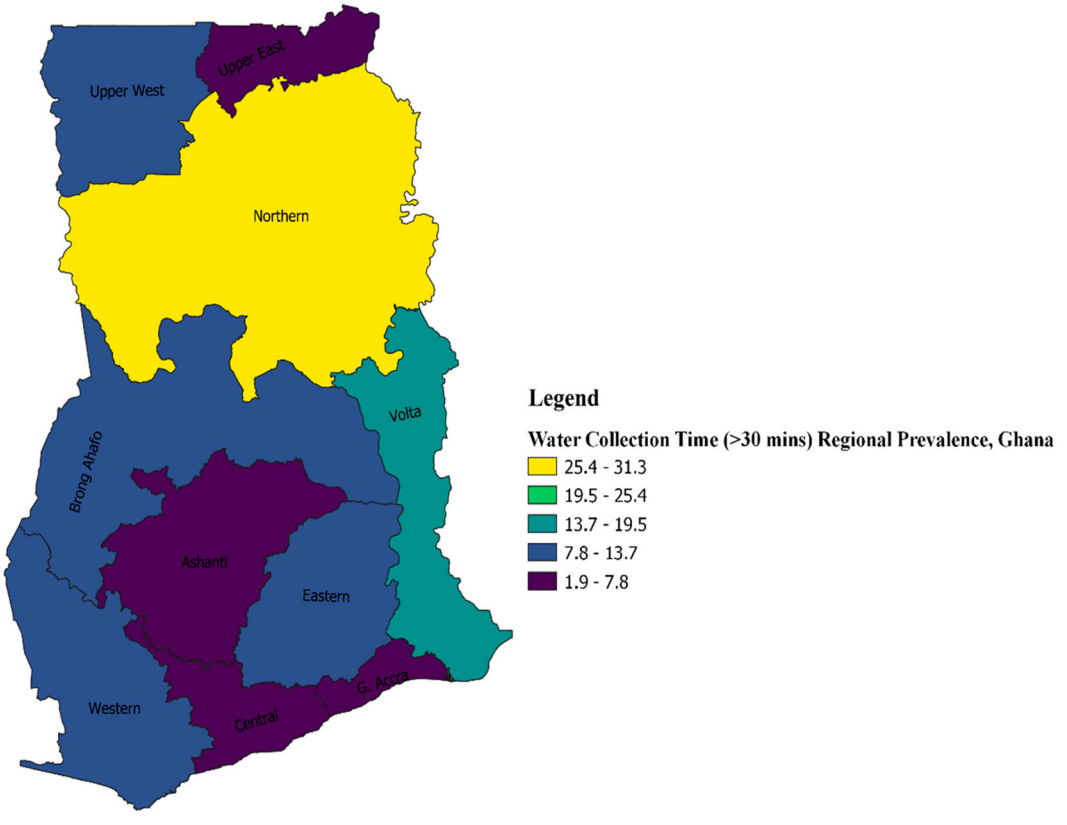

Figure 1. Household prevalence of spending more than 30 minutes to collect drinking water, Ghana.

households spent more than 30 minutes to collect drinking water (8.6%) which differed between those accessing improved and unimproved water sources and among household characteristics. This finding is lower than other reports on water collection in Ghana (Dongzagla, Nunbogu, and Fielmua 2020), perhaps due to differences in observations and methodological approaches in measuring water collection time. While it may be argued that the average time households spend in water collection is too small to warrant serious attention, our objective in this article is not only to demonstrate the time-consuming nature of water access but, rather, to explore the heterogeneities and how household socio-economic dynamics influence time allocation for fetching water and the distance to water points. Given that water collection can also be physically demanding, 8.6% of a population walking or trekking to a water source whose quality is unknown is by no means insignificant and warrants discussions for water policy, particularly concerning its health implications. Previous studies have pointed out that when water collection time is more than 30 minutes, it limits water collector's productive engagement and has implications on their health and well-being (Abrefa Busia 2022; Geere and Cortobius 2017; Howard et al. 2020). In this study, we found that source of drinking water, gender, wealth quintile, level of education, currently married people, place of residence and region of residence were significantly associated with higher drinking water collection time or water collection poverty in Ghana.

Households with unimproved drinking water sources were likely to spend more time to collect water. The practice of spending more than 30 minutes has been argued to limit the quantity of water collected below the basic requirement of 20 litres/capita/day, leading to poor consumption, limited hygiene practices and health problems (Brown, Cairncross, and Ensink 2013; Howard et al. 2020). This raises serious questions about why people should spend more time and long distances

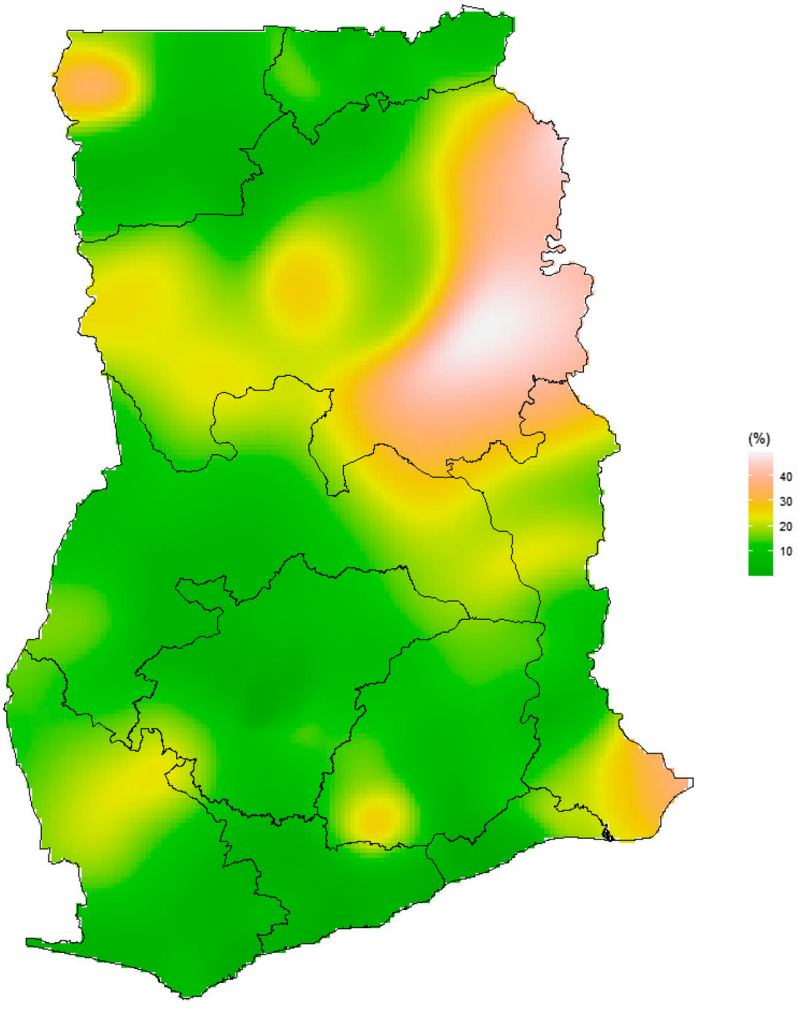

Figure 2. Prevalence (%) of drinking water collection time poverty estimated by Gaussian kernel estimator approach.

to access unimproved water sources. Though this study focuses on a single metric on water security (accessibility), the findings point to the broader milieu of water security evidenced in the country such as poor water quality and inadequacy (Addo, Amankwaa, and Gyasi 2019; Amankwaa and Ampratwum 2020; Awuah, Nyarko, and Owusu 2009; Peloso and Morinville 2014). For instance, relatively recent data shows that close to 80% of households have *E. coli* in their drinking water (GSS 2019). This particularly is a condition which people without access to good water infrastructure cannot do much about and which might at the same time be very distant from their homes.

In terms of gendered household dynamics, female headed households were more likely to spent more than 30 minutes to fetch drinking water. This is because women and girls are often the carriers and fetchers of household water. From the literature, women and (young) girls have been highlighted to be those mostly burdened with water collection and are mostly at risk of water poverty incidence (Gambe 2019; UN 2015). In fact, water scarcity has been highlighted as a source of water collection time poverty among women due to the many roles and responsibilities they play at the household level, which often require usage of water (Graham, Hirai, and Kim 2016; Jeil, Abass, and Ganle 2020).

As expected, households headed by persons with no formal education or having a primary education were more likely to spend more than 30 minutes for collecting drinking water. It could be argued that since such persons have poor educational backgrounds, they are unable to get decent employment that could help them afford on-premises water points. Hence, their poor educational backgrounds which is linked to their low economic conditions may provide a basis for their greater time spent to access water. By contrast, educated household heads tend to use their social and economic resources to provide their households with on-premise water points. These individuals leverage their financial resources and social capital (through for example, house helps) when it comes to fetching water or paying extra for water services, thereby reducing the overall time spent to collect water. Thus, persons with higher education tend to avoid "chasing for water" (Peloso and Morinville 2014) and the associated struggles for accessing water. As has become a common and growing practice, such individuals are more likely to employ the services of water drilling companies to construct improved boreholes and wells which have pumps to provide constant water access at homes.

Currently, married individuals were significantly more likely to spend more drinking water collection time compared to never married persons. This finding points to the extra layer of responsibility that married persons, particularly married women, face in accessing water for household needs. In line with socio-cultural norms and traditional marital values, (married) women tend to spend a greater amount of time in household chores, which often require usage of water. Thus, married women in many societies, especially in sub-Saharan Africa are often expected to manage household needs, including the collection of water for domestic uses (Abrefa Busia 2022; Gambe 2019). In addition, where married couples have children, considerations of childcare duties may likely increase the overall time spent to collect water as the number of household members become greater than those unmarried or separated.

Consistent with other studies (e.g. Gambe 2019; Songsore 2008; UN 2015), we also found a significant association between household wealth status and drinking water collection time. Poor (poorest and poorer) households were more likely to spend more than 30 minutes collecting water than wealthier people. Issues of water accessibility among the poor and vulnerable households is widespread in sub-Saharan Africa (Peloso and Morinville 2014) due to the time taken to collect water and more often the waiting time that individuals in such households' experience in accessing water. In view of these challenges, coupled with Ghana's emerging population and widening inequalities, the country is likely to miss its 2025 target of ensuring access to water for all (MWRWH 2007). It is important to note that household wealth and the quality of water infrastructure at the community level directly affect the decision to allocate hours to water collection (Mahama, Anaman, and Osei-Akoto 2014). It is difficult for some households, especially poor households to access water regularly due to their low-income levels to afford on-premises tap water infrastructure and standardised water systems of provision. Indeed, in Ghana, household water connection is increasingly problematic which perhaps pushes people to rely on off- premises water points/ sources. Although there have been pro-poor interventions such as the Low-Income Support programme (LICSU) by Ghana Water Company Limited, the state public utility company, their attempts to target poor households have often been problematic.

Another key finding of this study is that rural households were more likely to spend more time in collection drinking water compared to urban households. This could be that most rural communities are often characterised by off-premises water points. For instance, though recent Joint Monitoring Programme data shows that 23.6% of rural Ghanaian households rely on pipe-borne water as their main water supply, more than half of these people are likely to obtain water from public standpipes and shared connections which often require walking to distant locations outside the home (GSS 2014). As such, rurality increases the likelihood of expending greater time fetching water over long distances. This can also be explained by the colonial legacy of segregation and/or current political settlements which characterise water infrastructure development and governance in Ghana. Historically, due to political incentives, investments for the sector have favoured large

urban water projects and infrastructure development to the neglect of rural areas. It is argued that politicians often target visible projects in urban areas to appeal to urban voters (Nathan 2016), who are more dominant and politically active than those in rural areas.

Moreover, regional distribution for water collection time poverty was found to be disproportionate. The Northern, Volta and Western regions had the highest prevalence of water access and collection time inequalities which were supported by the spatial mappings. These three regions showed a significant association with drinking water collection time and households in these regions were more likely to spend more than 30 minutes in collecting drinking water compared to those in Greater Accra region. Several reasons may explain these findings. First, the Western region increasingly suffers from rampant small-scale mining as well as illegal mining (*galamsey*) activities which have over the years become a matter of national and international concern with regards to the increasing spate of pollution of water bodies, notably River Ankobra and River Pra (see, e.g. Arthur-Holmes et al. 2022). As such, rivers and other water systems utilised by individuals and communities have come under severe destruction, making it difficult for water service providers to service various communities that are sourced from the water bodies. Under such circumstances, household members, especially women and children in the Western region may be compelled to trek for drinking water in distant locations. Concerning the Volta and Northern regions, these regions are characterised by high multi-dimensional poverty issues such as water and sanitation poverty (GSS 2020). Hence, most households may find it difficult to have pipe-borne water within or closer to their homes, increasing the time and distance for water collection.

Strikingly, the case of Northern region being the severest region with water collection time poverty poses critical concerns for individuals and households. As our findings show, about half of all households spent more than 30 minutes for water collection. This was particularly high in the north-eastern part of the region which showed the severest incidence of spending more than 30 minutes to collect drinking water. As such, the intra-regional water access heterogeneity sheds light on the complexity and markedly different experiences of water collection time. This heterogeneity raises two fundamental issues– economic access and spatial access. Economically, most of the poor in this region cannot afford the initial high cost of grid water connections/facilities, regardless of whether they are in urban or rural areas. Spatially, the poor, especially, are often confined to areas without municipal services (Amankwaa and Ampratwum 2020). Even where they can afford, they might be quite a distance away, often due to the sparse population densities, resulting in additional transaction and time costs. As previous research has shown, high housing costs may cause the urban poor to aggregate at the fringes of cities, where services are unavailable, but where newcomers arrive with hopes of gaining access to water and other services in the near future (Gough and Yankson 2011). It can similarly be explained by the political economy literature, since the Northern regions and its sub-national belt of the country, have a history of low deployment of state capacity and rural-urban divides which have implications for water infrastructural development and service functionality (Ampratwum 2022). Again, the extreme weather conditions in the Northern region also accounts for the severity of time used for water collection. This is because most geographic areas in the region experience relatively short periods of rainy season compared to the dry season. This situation is further worsened by climate change variability, which affects the White Volta River's capacity to supply the needed volume of water to various households in the region, especially Tamale and its environs.

Limitations

Despite the strengths of this study, which includes the use of a nationally representative data that can be generalised to the wider Ghanaian population and being, to the best of our knowledge, the first to examine the prevalence and factors associated with water collection time inequalities in Ghana involving the of use geo-spatial visual mapping visualisations to show water collection time poverty, there are some limitations. First, because the 2014 DHS data is based on a cross-

sectional survey, the study results cannot establish causal relationships and also susceptible to self-reported biases. Further study can adopt direct observations to strengthen this. Also, the lack of micro level data limits insights into contextual and sub-national variations in term of water collection poverty. Second, following a referendum in 2019, there has been changes to the administrative demarcation of Ghana's regions leading to the current total of 16 regions instead of the original 10 regions as at the time of the 2014 DHS data collection. For instance, the new Savannah region, which occupied the same geographic space as Northern region was carved out of the latter. While this may limit interpretation of data especially for the initial 10 regions which have been re-demarcated to create new ones, the geo-spatial analysis in terms of the geographies of space occupied is still relevant. For example, the Northern region which lies eastwards of the newly created Savannah region, still remains the region with the highest water access inequalities, as it has not been affected by the recent re-demarcation.

Conclusions and policy implications

The evidence illustrated here is that collection time inequalities are profound and varies across different socio-economic groups and spatial locations. We found that the poor, women, uneducated and resource-constrained regions and areas tend to experience acute water collection inequalities. These factors also shape people choices of water source and the time allocation for fetching water and the distance to water points. To this end, an understanding of the "everydayness" of water collection poverty and inequality is fundamental for social and water policies that emphasise on surveillance and monitoring of access to water. Additionally, it helps to raise and re-emphasise critical policy questions which are central to the social policy of drinking water security in the Global South such as: How should water be distributed and allocated especially for the poor and vulnerable? and what policies and programmes or measures are needed to cope with the distributional impact of water services? Ghana and most importantly the world is already off track to achieve the SDG 6, however, innovative management, sustained funding and an effective and successful implementation of social policies in the water sector will be crucial to accelerate the universal goal of improving access to water.

Though the findings of this study are exploratory in nature, they reflect wider concerns and debates about the accessibility, inclusivity and affordability of water services. Also, the water collection problems discussed so far clearly exemplify the range of substantial issues endured by water-insecure and poor households across diverse rural and urban contexts. From our findings, some policy implications emerge with respect to the global goal of accelerating progress towards universal drinking water security as espoused by the SDG 6 target.

First, effective social policies such as pro-poor water interventions should be prioritised and be effectively targeted to hotspots and institutions working in those areas. This can be done by investing in targeted subsidised modular and decentralised infrastructure such as water ATMs and standpipes to off-grid and rural areas within closer population density, and piped connections to households. Within this, structures and bodies such as PURC should be empowered to properly target the most vulnerable populations such as people living in informal urban settlements, the rural poor and those who rely on daily wages that do not have access to water services. Existing subsidy programmes such as LICSU can also be scaled beyond Accra. Second, given that issues about inclusivity, equality and sustainability are core to water services and access, the country's National Water Policy need to reflect these current agendas. Translating Ghana's water policy targets such as those in the 2007 National Water Policy (NWP) and the WSSD Plan (2012–2025) have increasingly remain a challenge. Not only is the existing 2007 policy outmoded but, in principle, contradicts itself by pushing for privatisation of water and also supporting equitable access to water which cannot coexist in a future water policy (Monney and Ocloo 2017), unless vibrant and pro-poor institutional and regulatory frameworks, and clear accountability mechanism are in place to support and cater for marginalised and poor households.

Third, greater attention should be paid by policymakers and other relevant stakeholders to address regional differences in water collection inequalities, especially in the Northern region, where severity of water poverty concerning time spent and distance to access water is predominant by extending multisectoral partnerships. In this regard, the efforts of the Catholic Relief Services to partner the Ghana Water Company Limited and other organisations towards addressing water access issues in Tamale, through the Tamale Water Fund, is a laudable initiative. Also, the menace of illegal mining, especially in the Western region, also need pragmatic and timely policy interventions. These may include improving youth livelihood vulnerabilities in order to fully curb this phenomenon and its widespread impacts on water bodies, that ultimately affect households' time spent on water collection in the region.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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