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Assessment of Potential, Management and Sustainability of Water Sources in the Northern Region of Ghana

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Abstract - This paper presents a case study which describes the major factors affecting the management and sustainability of water sources and the potential of the water sources for dry season small scale irrigation. The paper also presents projections for future domestic water demand and drew implications of the results in terms of vulnerability of the districts to water stress. Water availability and sufficiency assessment was carried out in twelve communities of three different districts of Northern Ghana. Questionnaires were administered and measurement of yield of water supplies in Savelugu-Nantong, Karaga and Gushiegu Districts were done. In addition, information on meteorological and crop data were collected for the study. Analysis of the water sources showed that boreholes, wells, rivers, streams and dug-outs were seasonally affected in terms of the water availability and supply with few boreholes having the potential of meeting domestic and irrigation water requirements in the dry season. Results from the current and projected population showed that water sources were insufficient in the study area leading to congestion at water supply points with more communities likely to be vulnerable to water scarcity. The prevalence of water- related diseases except guineaworm was still high in the study area. The high prevalence of water-related diseases was, however, attributed to poor sanitation and hygiene practices. Results of the study also revealed poor management and sustainability of the water sources due to inappropriate siting, geological limitations, poor design and construction of water sources. Other factors include inactive Water and Sanitation Committees, lack of community's sense of ownership and inability to generate sufficient incomes. Generally, stand pipes can be recommended for the people since the water is clean, safe and accessible without much use of human energy as is the case with the other sources.

Key Words - Water availability, Household water supply and demand, Irrigation water requirement, Savelugu-Nantong District, Gushiegu District, Garaga District.

INTRODUCTION

Freshwater resources are essential for the survival of humans and other organisms on the planet. However, the increasing demand for freshwater resources due to population growth, urbanization, and industrialization has led to significant freshwater scarcity in many parts of the world (Musie & Gonfa, 2023) to the extent that water is now a top global risk (World Economic Forum, 2023). Poor management of freshwater resources has also contributed to the deterioration of water quality, degradation of ecosystems, and loss of biodiversity (Botha et al., 2022; UN Water, 2018).

Globally, the management of freshwater resources has been a subject of debate, and various frameworks have been developed to ensure the sustainable use and management of these resources. The United Nations 2030 Agenda for Sustainable Development recognized the importance of freshwater management and included a dedicated goal, Goal 6, which aims to ensure the availability and sustainable management of water and sanitation for all by 2030 (United Nations Development Programme, 2019). Additionally, the United Nations General Assembly designated 2018–2028 as the International Decade for Action on Water for Sustainable Development, to promote the sustainable management of freshwater resources (UN Water, 2018).

Freshwater resources are a critical component of human survival and development, and their management and ownership have become increasingly important in recent years due to population growth, urbanization, and climate change (UN Water, 2019). The management and ownership of freshwater resources are complex issues that require consideration of various perspectives and stakeholders, including governments, communities, and private sector actors (Krause et al., 2017). According to the United Nations, freshwater resources are under increasing pressure, and more than 2 billion people worldwide lack access to safe drinking water (United Nations, 2021) bringing about water insecurity (Musie & Gonfa, 2023). This has led to a growing concern for the management of freshwater resources as the global population continues to grow.

In Africa, freshwater resources are crucial for economic development, food security, and poverty reduction (Ahmed et al., 2022). However, the management and ownership of freshwater resources are often characterized by conflicts and tensions due to a lack of clarity regarding property rights and governance arrangements (Bosch & Gupta, 2022; Grafton et al., 2019).

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In Ghana, the management of freshwater resources is also a significant challenge. Although Ghana has significant freshwater resources, including rivers, lakes, and underground water, these resources are under increasing pressure due to population growth, urbanization, and climate change (Food and Agriculture Organization of the United Nations, 2020). The situation is further complicated by issues such as pollution, illegal mining, and inadequate infrastructure for water supply and sanitation (Ghana Statistical Service, 2021).

Research Objectives

The main objective of this study was to assessed the major factors affecting the management and sustainability of water sources in the three districts of Northern Ghana.

Specific objectives are to:

- Determine the potential of the water sources for dry season small scale irrigation,
- Make projections for future domestic water demand and draw implications of the results in terms of vulnerability of the districts to water stress and
- Determine the major factors affecting the management and sustainability of water sources

Research Questions

- What is the potential of the water sources for dry season small scale irrigation?
- What is the future demand of water for domestic activities?
- What are the major factors affecting the management and sustainability of water sources?

Physical Characteristics of the Study Areas

Savelugu-Nantong District is located roughly between latitudes 9° 45'N and longitudes 0° 50'W. It shares boundaries with West Mamprusi in the North, Karaga to the East, Tolon/Kumbungu in the West and Tamale Metropolitan Assembly to the South. The total land area is 1790.70 km^2. The district is generally flat with gentle undulating low relief. The altitude ranges between 122 - 244 m above sea level with the southern part being slightly hilly and sloping gently towards the North.

The main drainage system is made up of the White Volta and its tributaries. The area receives an annual rainfall averaging 1000mm, considered enough for a single farming season with maximum and minimum temperatures of - 40ºC and 16ºC respectively.

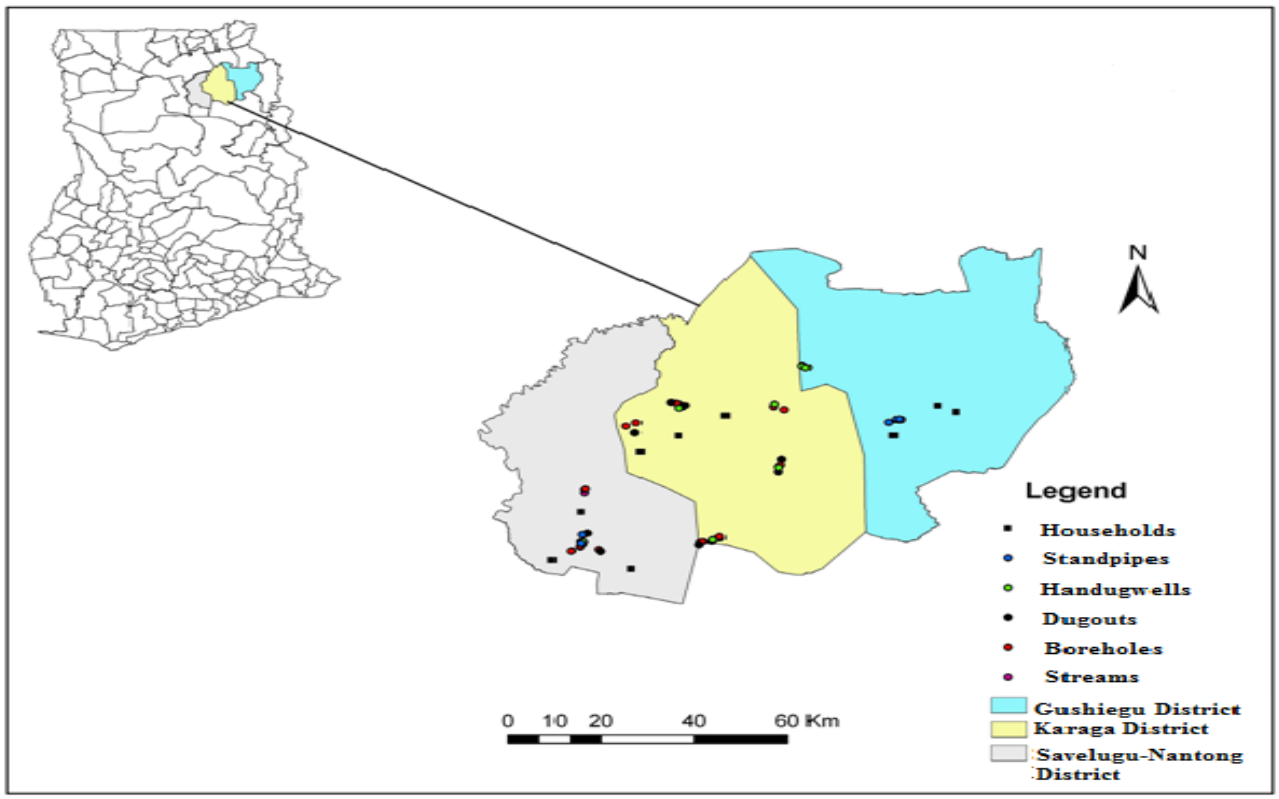

Figure 1: A map of Ghana showing the location of Savelugu-Nantong, Karaga and Gushiegu Districts with water facilities and households

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Gushiegu District is located in the north eastern corridor of Northern Region, roughly between latitudes 9° 55' 17''N and longitudes 0° 13' 06''W. It is bordered by four other districts in the region, namely; Savelugu/Nanton and Karaga Districts to the west, Saboba/Chereponi to the east, East Mamprusi to the north, and Yendi to the South. The total land area of the district is approximately 5,796 km^2.The topography of the land is generally undulating with elevations ranging from 140m at valley bottoms to 180m at highest plateaus. The major river draining the district is River Nasia, which flows between Nambrugu and Bagli. The area receives an annual rainfall averaging 1000mm, considered enough for a single farming season with maximum and minimum temperatures of 42^o C and 17^o C respectively.

Karaga District is located in the North-Eastern part of Northern Region, roughly between, latitudes 9º30' South and 10º30' North and longitudes 0º East and 45' West. It has a total area of 2,958 km^2. It shares boundaries with four districts in the Northern Region, merely West and East Mamprusi to the North, Savelugu/Nanton to the West and Gushiegu (the mother district) to the South and East. The only major river identified is River Nasia which flows between Namburugu and Bagli. The Nasia and it tributaries divide the district into two (north and south) making the northern half inaccessible especially during the rainy season. The area receives an annual rainfall averaging 1000mm, considered enough for a single farming season with maximum and minimum temperatures of - 42^o C and 16^o C respectively.

Materials and Methods

Both qualitative and quantitative data were collected including discussions with local communities and stakeholders of rural water supply schemes in the three districts. In addition, field surveys and measurements were conducted together with interviews using questionnaires to collect information on water demand and consumption patterns.

Thirty years (1980-2010) rainfall data from the Tamale Meteorological Services Agency was collected and analyzed. The number of dry days (*dd*) was determined and the average annual rainfall (R) was computed as follows;

$$\mathrm{R} = \sum_{i}^{30} P \text{, mm/y} \qquad [1.0]$$

Where, P is Total annual rainfall data for 30 years.

A survey was carried out at Savelugu-Nantong, Gushiegu and Karaga Districts to assess the existing water supply sources in terms of their availability and sufficiency for domestic activities. A total of two hundred and forty (240) households were surveyed and members were interviewed using a questionnaire. Information was solicited from households on socio-economic issues, water collection and daily water consumption using simple random sampling. Information on household daily domestic water consumption (Q) in the districts was also collected. Women and children were the main stakeholders. The quantities of water consumed by households were based on the water quantities consumed daily. The average quantity of water consumed (Q_v) by households in each district was computed and the per capita water consumption was also determined for each of the three districts, using Equation 1.1:

$$C = \frac{Q_v}{n \times 1day} \text{, litres/person/day} \qquad [1.1]$$

Where:

- Q_v: Average household water consumption (litres)
- C: Per capita water consumption (litres/person/day)
- n: Average household size.

The expected domestic water use by the year 2030 was estimated by assuming that the per capita use in the year 2030 would be at the same level as it were in 2010. Thus the only factor affecting the level of water use for domestic purposes is the growth in population. Therefore population forecasts for Savelugu-Nantong, Karaga and Gushiegu Districts of the Northern Region for the year 2030 were obtained for each of the three districts as follows:

$$\mathrm{P_n} = \mathrm{P_o}\, e^{nt} \qquad [1.2]$$

Where ÷

- P_n = Projected population
- P_o = Present population
- n = Period of projection
- t = Population growth rate

Available water yield test were conducted on available water facilities in the study communities. These included boreholes, hand dug wells, public stand pipes and dams. This data was required to establish whether the water supply yields were capable of

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meeting domestic water needs.The Food and Agriculture Organisation (FAO) Modified Penman-Monteith method was used to determine ET_c and hence IWR. The relation is given as:

$$ET_c = K_c \times ET_o \quad [1.3]$$

$$IWR = ET_c - Pe \quad [1.4]$$

Where:

- ET_C = Crop evapotranspiration
- K_C = Crop coefficient
- ET_o = Reference crop evapotranspiration
- P_e = Effective precipitation
- IWR = Irrigation water requirement

Results and Discussions

Household Socio-Economic Characteristics

The average household size was 9, 8, 7 persons per household for Savelugu-Nantong, Karaga and Gushiegu Districts respectively. This excluded members who reside outside the household for more than six months. The relatively large household size could be attributed to polygamous marriage practiced by the people in these communities.

Future Domestic Water Demand

Table 1: Projected Population Growth to the Year 2030

Districts	Communities	2000	2005	2010	2015	2020	2025	2030
Gushiegu	Limo	882	1025	1191	1384	1608	1868	2170
	Zinindo	2239	2601	3022	3511	4079	4739	5506
	Gushiegu	13693	15909	18484	21475	24950	28988	33679
	Gaa	1329	1544	1794	2084	2421	2813	3268
Savelugu-Nantong	Savelugu	24937	28973	33662	39110	45439	52793	61337
	Nabogu	960	1115	1296	1506	1750	2033	2362
	Libga	476	553	643	747	868	1009	1172
	Bunglung	665	773	898	1043	1212	1408	1636
Karaga	Nangunayili	431	493	503	576	659	754	863
	Nanduli	279	319	365	418	478	547	626
	Pishigu	3414	3908	4473	5110	5849	6694	7662
	Bagurugu	1664	1905	2180	2495	2856	3269	3741

The data presented in Table 1 indicates that the highest relative increase in population that is likely to occur during this period (2000-2030) is in the Savelugu-Nantong District which is closely followed by Gushiegu and Karaga Districts respectively. In fact, all the three districts have shown population growth in excess of national average and it is observed that, the populations in the Districts may double during this period by 2030.

Vulnerability of Districts to Water Stress

Vulnerability of a district to water stress is presented using the combined water availability-demand measure. Various districts are shown by per capita availability and demand in Table 2

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Table 2: Vulnerability of Districts to Future Water stress in the Dry Season

Districts	Communities	Average water demand (l/c/d)	2010 Population	Projected population to 2030	Projected average domestic water demand per day (m^3) to the year 2030	Total available water per day (m^3)
Savelugu-Nantong	Savelugu	21.67	33662	61337	1329172.79	856.89
	Nabogu	22.11	1296	2362	52223.82	37.80
	Libga	22.22	22.22	1172	26041	17438.08
	Bunglung	22.89	22.89	1636	37448.04	5826.33
Gushiegu	Gushiegu	22.29	18484	2170	48369.30	278.8
	Gaa	21.00	1794	5506	115626	36.12
	Zinindo	21.71	3022	33679	731171.09	60.06
	Limo	20.57	119	3268	67222.76	40.32
Karaga	Pishigu	19.13	19.13	863	16509.19	87.78
	Bagurugu	21.13	21.13	626	13227.38	10.92
	Nangunayili	19.75	19.75	7662	151324.50	56.70
	Nanduli	20.50	20.50	3741	76690.50	55.02

In Savelugu-Nantong District, Libga and Bunglung communities which have relatively small water users would not become vulnerable to water stress in 2030 due to large availability of water. However these factors should be kept in mind that:

- The balance of supply and use of water is based on district average domestic demand and
- Seasonal variability in the availability of water and its use was not considered.

In communities, such as Limo, Gushiegu, Zinindo and Gaa in the Gushiegu District, water demand in 2030 may be higher than water supply. Pishigu, Bagurugu, Nangunayili and Nanduli communities in Karaga District may also become vulnerable to water stress in 2030.
It is, however, shown in Table 2 that due to the existence of the two large irrigation dams at Bunglung and Libga communities with other stand pipes and groundwater facilities in Savelugu-Nantong District, it is the only district among the three districts that may not be vulnerable to water stress in 2030.

Table 3: Water demand and available water in the study communities in the dry season

Districts	Communities	Current Population (2010)	Average per capita water demand (litres)	Total domestic water demand per day (m^3)	Total available yield of groundwater facilities per day (m^3)	Surplus water available for any activity per day (m^3)	Total surplus water available over dry period of six months (m^3)
Savelugu-Nantong	Libga	643	22.22	14.29	31.08	16.79	3022.2
	Bunglung	898	22.89	20.56	25.20	2.31	415.8
	Nabogu	1296	22.11	28.66	37.80	9.14	1645.2
	Savelug	33662	21.67	729.46	18.90	Nil	Nil
Karaga	Nangunayili	503	19.75	9.93	56.70	46.77	8418.6
	Nanduli	365	20.50	7.48	55.02	47.54	8557.2
	Pishigu	4473	19.13	85.57	87.78	2.21	397.8
	Bagurugu	2180	21.13	46.06	10.92	Nil	Nil
Gushiegu	Limo	119	20.57	2.45	40.32	37.87	6816.6
	Zinindo	3022	21.71	65.61	60.06	Nil	Nil
	Gaa	1794	21.00	37.67	36.12	Nil	Nil
	Gushiegu	18484	21.29	393.53	17.64	Nil	Nil

From Table 3, it implies that the estimated total surplus available water from the current functioning water supply facilities for any activity over the six months dry period in the various communities of the three districts are:

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a). In Savelugu-Nantong District

i) For Libga community: 3022.2 + 17407 = 20429.2 m^3
ii) For Bunglung community: 835.2 + 5801.13 = 6636.33 m^3
iii) For Nabogu community: 1645. $2m^3$

17407m^3 and 5801.13m3 are volumes of water from existing dams in the dry season

b). In Karaga District

i) For Nangunayili community: 8418.6 m^3
ii) For Nanduli community: 8557.2 m^3
iii) For Pishigu community: 397.$8m^3$

c). In Gushiegu District

i) For Limo community: 6816.6 m^3

Irrigation Potential of the Available Water
Crop Water Requirement for Tomatoes in the Three Districts

Table 4: Crop Calendar for Tomato (*Lycopersicon esculentum*) Production in the Dry Season

Crop development stage	No. of days	Date	Kc
Initial	35	15thOct-18th Nov	1.05
Crop development	45	19th Nov-2nd Jan	1.054
Mid season	70	3rd Jan- 13Tth Mar	1.15
Late season	30	14th Mar-12th April	0.90

Table 5: Estimation of Crop Water Requirement of Tomatoes (*Lycopersicon esculentum*) in Savelugu-Nantong District for the Dry Season

Months	ETo (mm/d)	Kc	ETc (mm/d)	No. of days	ETc /month	Effective rain fall (ρe) in mm/ month
October	4.44	1.05	4.67	17	79.39	70.04
November	4.55	1.05	4.78	30	143.4	4.49
December	4.84	1.10	5.32	31	164.92	2.19
January	5.14	1.12	5.76	31	178.56	1.67
Februay	6.01	1.15	6.91	28	193.48	3.59
March	6.16	1.00	6.16	31	190.96	12.07
April	5.95	0.90	5.36	12	64.32	68.81
Total				180	1015.03	173.86

Kc, ETo and Pe were derived using 30 years climatic data from near meteorological station
Pe = 0.8ρ where the mean monthly rainfall, ρ > 75mm /month and
Pe = 0.6ρ where the mean monthly rainfall, ρ < 75mm /month
Irrigation water requirement (IWR) = Etc/month – ρe = 1015.03 – 162.86 = 852.17 mm

Table 6: Estimation of Crop Water Requirement of Tomatoes (*Lycopersicon esculentum*) in Karaga District

Months	ETo (mm/d)	Kc	ETc (mm/d)	No. of days	ETc /month	Effective rain fall (ρe) in mm/ month
October	4.44	1.05	4.67	17	79.39	67.69
November	4.55	1.05	4.78	30	143.4	1.65
December	4.84	1.10	5.32	31	164.92	0.65
January	5.14	1.12	5.76	31	178.56	0.48
Februay	6.01	1.15	6.91	28	193.48	1.15
March	6.16	1.00	6.16	31	190.96	6.59
April	5.95	0.90	5.36	12	64.32	64.65
Total				180	1015.03	142.86

Irrigation water requirement (IWR) = Etc/month – ρe = 1015.03 – 142.86 = 872.17 mm

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Table 7: Estimation of Crop Water Requirement of Tomatoes (*Lycopersicon esculentum*) in Gushiegu District

Months	ETo (mm/d)	Kc	ETc (mm/d)	No. of days	ETc /month	Effective rain fall (ρe) in mm/ month
October	4.44	1.05	4.67	17	79.39	72.78
November	4.55	1.05	4.78	30	143.4	1.86
December	4.84	1.10	5.32	31	164.92	0.91
January	5.14	1.12	5.76	31	178.56	0.44
Februay	6.01	1.15	6.91	28	193.48	1.57
March	6.16	1.00	6.16	31	190.96	9.53
April	5.95	0.90	5.36	12	64.32	67.71
Total				180	1015.03	154.80

Irrigation water requirement (IWR) = Etc/month – ρe = 1015.03 – 154.80 = 860.23 mm

Considering the GIWR of tomato being 1217.39 mm (≈1.22 m), 1245.96mm (≈1.25 m) and 1228.90mm (≈1.23 m) in Savelugu-Nantong, Karaga and Gushiegu Districts respectively, it implies that to irrigate a hectare of tomato, the total amount of water required in each of the districts can be calculated as given in Table 8:

a) For Savelugu-Nantong District;
Total GIWR = GIWR × Total area to be irrigated. (1ha = 10000m^2)
Total tomato GIWR = 1.22 m ×10000 m^2 = 12200 m^3 /ha.

b) For Karaga District;
Total GIWR = GIWR × Total area to be irrigated.
Total tomato GIWR = 1.25 m ×10000 m^2 = 12500 m^3 /ha.

c) For Gushiegu District;
Total GIWR = GIWR × Total area to be irrigated.
Total tomato GIWR = 1.23 m ×10000 m^2 = 12300 m^3 /ha.

Table 8: Gross Irrigation Water Requirement for Tomato

Districts	Total Tomato Gross Irrigation Water Requirement
Savelugu-Nantong	12200 m^3/ha
Karaga	12500 m^3/ha
Gushiegu	12300 m^3/ha

This pre-supposes that for the facilities in Savelugu-Nantong District, the current functioning facilities at Libga are capable of meeting domestic water demand and to irrigate about 1.67 ha of tomatoes, those at Bunglung can irrigate about 0.51 ha of the same crop whilst at Nabogu, irrigating about 0.23 ha is also possible which clearly not enough.

For Karaga District the current functioning facilities at Nangunayili are capable of irrigating 0.67 ha of tomatoes and those at Nanduli can irrigate 0.69 ha of tomatoes. However, in Gushiegu District the only community that has the facilities capable of meeting domestic water demand and can irrigate about 0.55 ha of tomatoes is Limo community. The potential may be higher in all the three districts, if crops with lower CWR like okro, *ayoyo*, or other leafy vegetables are grown as well as upon repairs of the broken-down water facilities in the various communities.

Management and Sustainability of Rural Water Supply Systems

The survey in the study area revealed that lot of management problems at the community level had serious threats to the sustainability of the facilities. This was clearly revealed in the state of the facilities in the twelve communities studied. For instance, out of a total of 50 hand pump water facilities in the twelve studied communities – 39BHs and 11 HDWs fitted with

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pumps, only 38 were functional whilst the rest of the 12 facilities were broken down or abandoned. See state of facilities in Figure 2 and Table 5.

Figure 2: Borehole with sanitation threats: scene at (A) Savelugu, (B)Zinindo and (C) Pishigu in Savelugu-Nantong, Gushiegu and Karaga districts respectively

Table 9: Summary of Statistics on Potable Water Facilities by Type, Total Number, Functionality, Rehabilitation and Privately-Owned

Districts	Communities	Type and number of facilities	State of the facilities		Number rehabilitated	Privately-Owned
			Functional	Non-functional		
Savelug-Nantong	Libga	2 BHs	2 BHs	Nil	Nil	Nil
	Bunglung	1 BH	1 BH	Nil	Nil	Nil
	Savelugu	4 BHs, 3 PSPs	3 BHs, 3 PSPs	1 BH	1	Nil
	Nabogu	3 BHs	2 BHs	1 BH	Nil	Nil
Karaga	Nangunayili	4 BHs, 2 HDWs	2 BHs	2BHs, 2 HDWs	Nil	Nil
	Nanduli	3 BHs, 2 HDWs	3 BHs	2 HDWs	Nil	Nil
	Pishigu	6BHs, HDW	6BHs, HDW	Nil	Nil	Nil
	Bagurugu	2 BHs	2 BHs	Nil	Nil	Nil
Gushiegu	Limo	2 BHs,	2 BHs,	Nil	Nil	Nil
	Zinindo	4 BHs, 1 HDW	3BHs, 1HDW	1 BHs,	Nil	Nil
	Gaa	2 BHs, HDW	2 BHs	HDW	Nil	Nil
	Gushiegu	3 BHs, HDW 3 PSPs	2 BHs 3PSP	BHs, HDW	Nil	Nil

The survey revealed that only one of the 13 broken boreholes was repaired with the rest being abandoned due to their inability to repair them and 15 out of the 17 dug-outs also have eroded embankments with high risk of siltation. Most of the mechanics and skilled personnel have also left the district for economic reasons.

Weak financial resources is another factor that contributes to the problems of poor maintenance and sustainability of the facilities in most of the communities.

The research found no evidence of good sanitation and hygiene practices among the respondents especially those in Karaga and Gushiegu Districts. For instance, to a question as to what constitute good sanitation and hygiene at a water facility site during focus group discussion with the WATSANs, the committee members easily mentioned things like weeding, cleaning, sweeping,

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repairing of pad, gutter or trough. However, site observations during this study showed nothing better than the pictures in Figure 4. This prompted the researcher to assess the health-based view that has been the driver of most rural water programmes. Information obtained from the District Heath Services has confirmed that cases of these water related diseases in the three districts have been very high among the top ten diseases in recent years which include diseases like typhoid, diarrhoea, malaria, intestinal worms and skin diseases with typhoid and malaria taking an upward trend especially during the rainy season. Cases of guineaworm were, however, rare and not found in the three districts. It is indeed, a proof of guineaworm eradication in the three districts; a success and progress that in the researcher's view could only be attributed to the efforts of the educational programmes on guineaworm eradication centred on water treatment by boiling and filtering. Statistics obtained from the three district health service departments on common water related diseases are as shown in Table 10.

Table 10: The state of dug-out facilities in the study areas in the dry season

Districts	Communities	Number of dug-out/dam	State of the facilities in dry season	
			Functional	Non-functional
Savelugu-Nantong	Libaga Bunglung Savelug Nabogu	1 Dam 1Dam 3 Dug-outs 1 Dug-out	Dam Dam Nil Nil	Nil Nil 3 Dug-outs Dug-out
Karaga	Nangunayili Nanduli Pishigu Bagurugu	Nil Nil 3 Dug-outs 2 Dug-outs	Nil Nil Nil Nil	Nil Nil 3 Dug-outs 2 Dug-outs
Gushiegu	Limo Zinindo Gaa Gushiegu	Dug-out 2 Dug-outs 2 Dug-outs Nil	Nil Nil Nil Nil	Dug-out 2 Dug-outs 2 Dug-outs Nil

Table 10 depicts the state of the dug-out facilities in the districts as was observed during the field survey. It also shows the validation of this finding and the assessment record of the districts on the functionality of these water facilities in the districts in the dry season. It clearly shows that out of the 16 dug-outs/dams in the studied communities only 2 dams in Savelugu-Nantong District were functioning in the dry season.

Table 11; Cases of water- related diseases in the districts (NRC = No Reported Case)

Districts	Diseases	Cases recorded during the past three years		
		2009	2010	2011
Savelugu-Nantong	Guinea worm	47	6	0
	Typhoid	2	3	1
	Diarrhoea	4	6	6
	Intestinal worm	NRC	NRC	NRC
	Malaria	90	58	23
	Skin disease	1818	2478	3003
Karaga	Guinea worm	3	1	0
	Typhoid	NRC	NRC	NRC
	Diarrhoea	1567	1760	1868
	Intestinal worm	NRC	NRC	NRC
	Malaria	9456	8419	10342
	Skin disease	201	178	170
Gushiegu	Guinea worm	1	0	0
	Typhoid	655	480	NRC
	Diarrhoea	2293	2011	3329
	Intestinal worm	495	NRC	518
	Malaria	19864	22195	19196
	Skin disease	1050	1337	1983

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Source: Savelugu-Nantong, Karaga and Gushiegu District Health Services (2009-2011)

Six cases of water-related diseases in Table 11 were not different among the three districts except that, cases of intestinal worms were not recorded in Savelugu-Nanton and Karaga Districts with Gushiegu District having an upward trend. It is therefore not clear if indeed, water sources and supply is sufficient enough to improve the lives of these rural folk economically and domestically. Comparing the cases of these diseases in the three districts, some upward differences exist in diarrhoea and skin diseases with Karaga alone having no report on cases of skin diseases. However, there were downward differences in the cases of typhoid disease with Karaga having no records. It is important to note that even though there are some differences in the prevalence of these diseases in the three districts, in reality the assessment of water sources in the three districts cannot be derived from these results. This is because the prevalence of each disease is equally high to the same extent in all the three districts. For instance the cases of malaria have reached an alarming stage in the three districts followed by diarrhoea with diarrhoea affecting both children and adults. However, all Community Health Nurses interviewed in all the three districts attributed it to the use of unsafe water sources coupled with poor hygiene and sanitation.

5. CONCLUSIONS AND RECMMENDATIONS

5.1 Conclusions

The research revealed that water demand out strips supply for domestic activities. Rapid population growth in the three districts has generated a situation of water stress and water scarcity. However, about two-thirds of the population of the studied areas representing two districts (Karaga and Gushiegu) may become vulnerable to water stress or water scarcity under current projections of population growth as shown in Table 2.

Health wise results of this research have shown that the provided rural water supply sources in the three districts have had insignificant health impacts on rural communities as a result of poor sanitation and hygiene practices in the three districts.

The yields of the water sources revealed a potential of some facilities for small scale irrigation. However, limited attempts were made in that regard due to lack of awareness of the potential.

5.2 Recmmendations

Because the production and delivery of improved water to rural households is costly, future studies could investigate and find solutions to the willingness to pay for improved water supply.

REFERENCES

[1] Ahmed, Z., Gui, D., Qi, Z., & Liu, Y. (2022). Poverty reduction through water interventions: A review of approaches in sub-Saharan Africa and South Asia. *Irrigation and Drainage*, *71*(3), 539–558. https://doi.org/10.1002/ird.2680.
[2] Bosch, H. J., & Gupta, J. (2022). The tension between state ownership and private quasi-property rights in water. *Wires Water*, *10*(1), e1621. https://doi.org/10.1002/wat2.1621.
[3] Botha, M., Oberholzer, M., & Middelberg, S. L. (2022). Water governance disclosure: The role of integrated reporting in the food, beverage and tobacco industry. *Meditari Accountancy Research*, *30*(7), 256–279. https://doi.org/10.1108/MEDAR-09-2020-1006.
[4] Food and Agriculture Organization of the United Nations [FAO]. (2020). The state of food and agriculture 2020. Overcoming water challenges in agriculture. https://doi.org/10.4060/cb1447en.
[5] Ghana Statistical Service. (2021). *Ghana living standards survey round 7*. Report on the district analytical report of the Bosomtwe district.
[6] Grafton, R. Q., Williams, J., Perry, C. J., Molle, F., Ringler, C., Steduto, P., Udall, B., Wheeler, S. A., Wang, Y., Garrick, D., & Allen, R. G. (2019). The paradox of irrigation efficiency. *Science*, *361*(6404), 748–750. https://doi.org/10.1126/science.aat9314.
[7] Krause, T., Bach, M., Lindenschmidt, K. E., & Lorz, C. (2017). Perspectives on integrated water resources management–progress, challenges, and the way forward. *Water*, *9*(10), 781.
[8] Musie, W., & Gonfa, G. (2023). Fresh water resource, scarcity, water salinity challenges and possible remedies: A review. *Heliyon*, *9*(8), e18685. https://doi.org/10.1016/j.heliyon.2023.e18685.
[9] UN Water. (2018). The United Nations World Water Development Report 2018: Nature-based solutions for water. https://www.unwater.org/publication_categories/the-un-world-water-development-report-wwdr/(open in a new window).
[10] UN Water. (2019). UN World Water Development Report 2019. https://www.unwater.org/publications/un-world-waterdevelopment-report-2019(open in a new window).
[11] United Nations. (2021). Water facts and trends. https://www.un.org/waterforlifedecade/facts_and_figures.shtml(open in a new window).
[12] United Nations Development Programme. (2019). Sustainable Development Goals: Goal 6—Clean water and sanitation. https://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-6-clean-water-and-sanitation.html(open in a new window)