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Domestic Water Stress and its Effects on Health in Selected Communities in Guyuk Local Government Area of Adamawa State, Nigeria

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Abstract: **This paper highlighted the incidences of domestic water stress in Lamza Tudu, Lamza Kaza and Gunda communities of Guyuk local government area of Adamawa State with a view to examine the effects of this phenomenon on the health condition of the people in the area. The communities were purposively selected and the respondents within selected households were randomly chosen. A total of 88 respondents, one each from the households provided the required information for the research. Results indicated that 90.9% of the households in the selected communities are water-stressed at domestic level and only 9.1% are not water-stressed. The correlation between domestic water stress and health results also shows a moderate negative relationship at r = -0.508 which is significant at p<0.000<p<0.05. With this scenario therefore, there is need to provide a sustainable measure to tackle water stress in the affected communities. Rainwater harvesting strategy should be designed for each household to capture water, store and treat for household use. This planning strategy will involve rainfall studies, households' water requirement and consumption so as to determine the size of tanks that will be appropriate for each household to store water for use especially during the dry season when the water stress worsens in the area.**

Keywords: **Domestic Water Stress, Health, Effects, Communities.**

I. INTRODUCTION

Water stress refers to economic, social, or environmental problems caused by unmet water needs [9]. "Water stress" also refers to the inability due to shortage or lack thereof, to meet human and ecological demand for water [8]. According to the World Business Council for Sustainable Development (WBCSD) in 2006, the concept of water stress is relatively simple: it applies to situations where there is not enough water for all uses, whether agricultural, industrial or domestic. Domestic water stress could be estimated as a ratio of domestic water supply of potable quality to domestic water demand/need [1]. Water stress is also a condition where an imbalance occurs between water demand/need and water availability consumed for meeting the need [2]. Compared to scarcity, "water stress" is a more inclusive and broader concept because it involves ecological, domestic, and industrial shortage of water. European Union (EU) in 2014 described water stress as a situation where there is a structural unbalance between the water needs and resources. AQUASTRESS (2008) is of the opinion that water stress occurs when the functions of water in the system do not reach the standards of policies and perceptions of the population in an appropriate quantity and quality at an appropriate scale. The United Nations (UN) and WHO recommended a minimum of 50 litres of water per capita per day preferably within 250 metres and not exceeding 500 metres of dwellings. The breakdown [4] of what is referred to as "Basic water requirement (BWR)" of 50 litres per capita per day or 18 m^3 per capita per year is as follows:

1. Minimum Drinking Water Requirement: Data from the National Research Council of the National Academy of Sciences was used to estimate the minimum drinking water requirement for human survival under typical temperate climates with normal activity is about 5 litres per person per day.

2. Basic Requirements for Sanitation: Taking into account various technologies for sanitation worldwide, the effective disposal of human wastes can be accomplished with little to no water if necessary. However, to account for the maximum benefits of combining waste disposal and related hygiene as well as to allow for cultural and societal preferences, a minimum of 20 litres per person per day is recommended.

3. Basic Water Requirements for Bathing: Studies have suggested that the minimum amount of water needed for adequate bathing is 15 litres per person per day.

4. Basic Requirement for Food Preparation: Taking into consideration both developed and underdeveloped countries, the water use for food preparation to satisfy most regional standards and to meet basic needs is 10 litres per person per day.

II. THEORETICAL AND CONCEPTUAL FRAMEWORK

Water influences the societal lifestyle and controls the livelihood as every activity is centred around water directly or indirectly. Social and economic development of a society has a link to availability of water because it is used in agriculture, industrial production, and at domestic level. The theory of social change which is a mechanism for measuring political, economic and technological changes in a society [7] is used to further buttress the relationship between the concept of water stress and the society. One of the major indicators of socioeconomic development that is affected by water stress is income. Income refers to wages, salaries, profits, rents, and any flow of earnings received. Income can also come in the form of unemployment or workers compensation, social security, pensions, interests or dividends, royalties, trusts, alimony, or other governmental, public, or family financial assistance [7]. Families or households (HHs) spent much time accessing water that they cannot engage in business ventures that earn them an income and some spend their income to buy water due to scarcity of the resource. There is a link directly or indirectly between water and socioeconomic development [6]. On health, water stress forces people to us stream water which are usually contaminated leading to illnesses due to water-borne diseases. Moreover, poor sanitation may result from water stress because little water is dedicated to cleaning or flushing toilets or sewages. Water stress also push people into using water from contaminated source(s) or buying water from an unknown source which may have been contaminated and eventually lead to illnesses like Schistosomiasis, cholera, diarrhea, bilharzias and typhoid fever among others. This research intends to examine the health effects of domestic water stress and how much of households income is diverted into buying water for domestic consumption as well as how businesses that brings in income to individuals and families have suffered a setback due to water stress.

III. MATERIALS AND METHODS

The paper utilised related materials from published sources such as journals and books on water stress and its effects on socioeconomic indicators. Data was collected from the field through interviews using a structured questionnaire. Three (3) communities namely Lamza Tudu, Lamza Kasa and Gunda were randomly selected for the study. Households were also selected at random in each community for interviews on access to water, distance to sources, time taken to collect water, quantity available vis-à-vis quantity required. The numbers of households are selected proportional to the size of the community. Therefore, a breakdown indicates that fifteen (15) households are selected in Lamza Tudu, fifteen (15) households in Lamza Kasa and fifty eight (58) households in Gunda, making a total of eighty eight (88) households in all the communities. One (1) respondent was randomly selected from each household for interview. The results were analysed using Correlation analysis where DWS was correlated with Health for the rural communities of Gunda, Lamza Tudu, and Lamza Kasa. Descriptive tools such as percentages and frequency were presented in Tables.

IV. RESULTS AND DISCUSSIONS

The study indicates that domestic water stress which manifests through the quantity of water for domestic consumption, affects the income and health status of the people of the five communities investigated. Three (3) of the communities namely Gunda, Lamza Tudu, and Lamza Kasa are rural communities with no protected or potable source of water. All the three (3) rural communities rely on water from river beds or flowing streams for consumption and other household uses

such as washing, bathing, cooking and sanitation among others. The standards provided in the Nigerian National Water Supply and Sanitation Policy (2000) stipulates an average of 30 litres per capita per day for rural areas and 60 litres per capita per day for semi-urban (small towns), whereas urban areas are 120 litres per capita per day. However, 30 litres per capita per day standard is adopted for rural communities in this paper to buttress the domestic water stress situation in the selected communities. The domestic water stress index (water requirement/availability per capita per day) of the communities is calculated.

The HHs water stress phenomenon in the sample communities in Guyuk LGA indicates that there is severe water stress in the area. Table 1 indicates that there is an average of 5 persons per HHs in Lamza Tudu, a community that relies on a dug well for water. Study shows that all HHs have access to little water per capita per day far below the recommended 30 litres per capita per day for rural communities in Nigeria. The quantity of water required per HHs are calculated by multiplying the number of persons by the 30 litres per capita per day as minimum recommended by National Water Supply and Sanitation Policy [5].

Table I: Lamza Tudu Domestic Water Stress Variables

Number of persons/ HH	Quantity of water required/HH/day (in litres)	Quantity Available/HH/day (in litres)	DWS (Qwa/Qwr)	Distance to water source(s) (in metres)
8	240	48	0.2	300
6	180	36	0.2	350
3	90	20	0.22	500
4	120	30	0.25	400
7	210	49	0.23	600
8	240	48	0.2	800
5	150	50	0.33	400
5	150	55	0.36	700
6	180	60	0.33	1000
2	60	25	0.41	600
4	120	27	0.23	400
3	90	20	0.22	450
5	150	50	0.33	430
4	120	34	0.28	350
6	180	60	0.33	550
Ave. No. of persons/HH 5.4	**Average quan. required/HH/day 162 Litres**	**Average quantity available/HH/day 42.1 Litres**	**Ave. 0.27**	**Ave. 565 metres**

The recommended standards are compared with the quantity of water available to HHs to estimate the stress index. Distances to water source(s) also shows that all HHs walk for an average of 500 metres to access water. Average quantity of water available to HHs is 42.1 litres as against the minimum quantity of water required for healthy and satisfying lifestyle. An average quantity of water required per HH in Lamza Tudu is 162 litres per day.

The situation at Lamza Kasa is a little bit different from that of Lamza Tudu. Average quantity of water available to HHs in Lamza Kasa is higher than that of Lamza Tudu. An average of 51.7 litres of water is recorded as quantity available for HHs in the community as against the average quantity required per HHs per day which is 154 litres (Table II). Lamza Kasa depends on a stream flowing through the community as its source of water. The people confirmed that they use water from the stream for all domestic activities and consumption especially during the dry season. During the rainy season, the community relies on harvested rain water for drinking and cooking but uses the stream water for washing, sanitation and bathing. Due to an acute scarcity of water during dry season, the residents affirmed that they bath and wash their clothes at the stream and carry water home for cooking and drinking. The residents dig up the sand in the river/stream bed to access water for all uses which they also share with their animals and that of the Fulani herdsmen. That is the extent of water stress in the area.

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Table II: Lamza Kasa Domestic Water Stress Variables

No. of persons/HH	Quantity of water required/HH/day (in Litres)	Quantity available/HH/day (in Litres)	DWS (Qwa/Qwr)	Distance to water source(s) (in metres)
10	300	70	0.23	400
3	90	20	0.22	300
5	150	50	0.33	200
7	210	60	0.28	700
5	150	50	0.33	300
6	180	60	0.33	500
7	210	50	0.23	400
2	60	25	0.41	600
6	180	80	0.44	350
5	150	50	0.33	250
5	150	60	0.4	400
4	120	50	0.41	500
4	120	40	0.33	200
6	180	80	0.44	100
2	60	30	0.5	300
Ave. no. of pers/HH 5.1	**Ave. quantity required/HH/day 154 Litres**	**Ave. quantity available/HH/day 51.7 Litres**	**Ave. 0.34**	**Average distance of 366.6 metres**

Gunda community is also not spared in the stress situation being a community that also depends on a stream/river as a source of water with an average distance to the source of 415 metres from their dwellings. A study result for Gunda community is presented on Table III. Investigation also revealed that this community competes with animals over water thereby exposing the people to diseases.

Domestic Water Stress Index (DWSI)

The domestic water stress index of the households within the study communities were investigated and presented within the context of the formula below:

$$DWSI = \frac{QWA_c}{QWR_c} = \frac{\sum QWA_h}{\sum QWR_h}$$

Where QWA_c is quantity of water available per capita $_c$,

QWR_c is quantity of water required per capita $_c$.

$\sum QWA_h$ is the summation of quantity of water available per household $_h$

$\sum QWR_h$ is the summation of quantity of water required per household $_h$.

Scaling range: 0.1-0.49 is severely water-stressed; 0.5-0.99 is partially water-stressed, 1 is no stress.

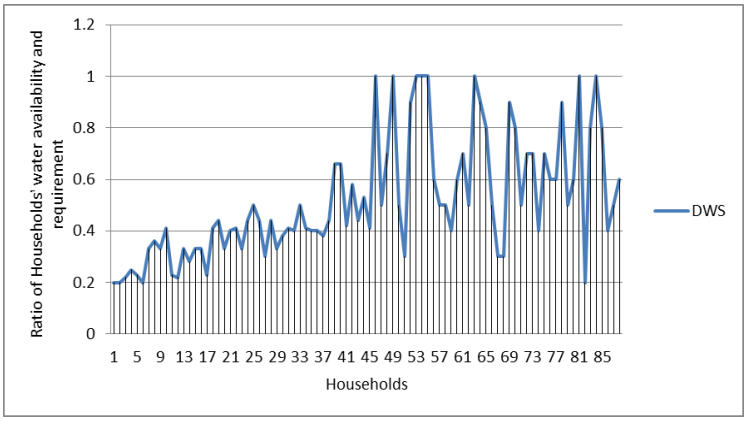

Fig.1: General Domestic Water Stress pattern in the selected communities

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Effects of Domestic Water Stress on Health:

Water stress has pushed people into using water from contaminated sources such as rivers, streams, ponds among others without any form of treatment or purification. The situation in the rural communities of Guyuk local government calls for a serious attention as the people are faced with challenges of drinking water from the streams and rivers in the area due to the inability of the epileptic wells to meet their demand. The scenario has caused many cases of waterborne diseases such as bilharzias, typhoid fever, dysentery, diarrhoea, cholera and skin rashes among others in the area. Correlation analysis of DWS and health on a 2-tailed approach for Lamza Tudu, Lamza Kasa and Gunda communities were carried out. Results indicated that correlation between DWS and health is significant at $p<0.05$ (2-tailed) and negatively correlated at $r = -0.508^{**}$ (50.8) (see Table IV). This means that as the values (quantity of water) of domestic water stress is increasing, the incidences of diseases is decreasing.

Table III: The nature of Domestic Water Stress and Water related illnesses in Guyuk LGA

Variables	**Frequency**	**Percentage (%)**	**Mean**	**Standard Dev.**
Water stress	80	90.9		
No stress	08	9.1	1.091±	0.289
Total	**88**	**100**		
Health				
None	08	9.1		
Diarrhea	23	26.1		
Dysentery	24	27.3		
Bilharzias	20	22.7		
Typhoid fever	08	9.1		
Cholera	04	4.5		
Others	01	1.1	2.148±	1.344
Total	**88**	**100**		

Table IV: Correlation between Domestic Water Stress and Health

Elements	**Domestic Water Stress**	**Health**
Domestic Water Stress		
Correlation Coefficient	1	-0.508**
P-value		0.000
Decision		p<0.05

Domestic water stress is very high in the area and this also impacted negatively on the health condition of the people of the area. The information on Table III shows that 90.9% of the households in Lamza Tudu, Lamza Kasa and Gunda communities are water stressed (52.3% are severely stress and 38.6% are partially stressed) while only 9.1% are not water-stressed at domestic level. The detail of the water stress pattern is presented in Fig.2 and Table V.

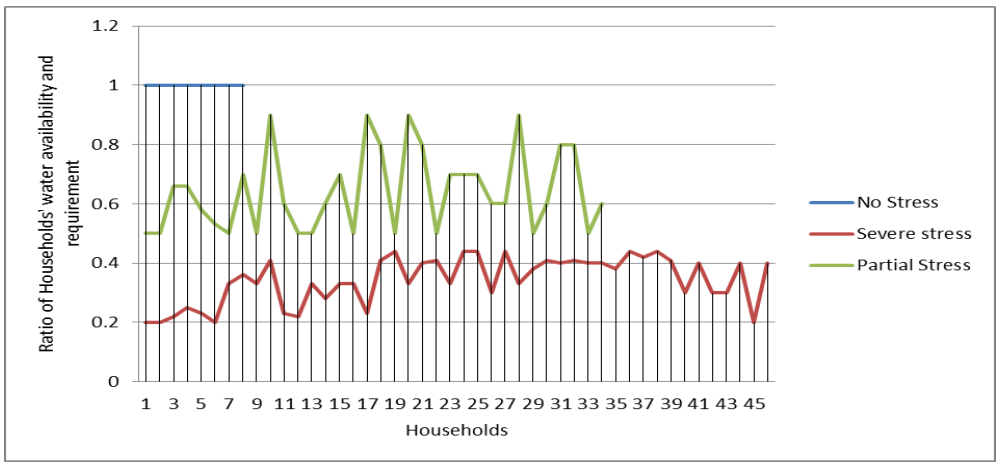

Fig. 2: Level of Domestic Water Stress pattern in selected communities of Guyuk LGA

Table V: Level of Domestic Water Stress in the affected Communities of Guyuk

DWS patterns	Frequency	Percentage (%)
No stress *(1+)*	08	9.1
Severe stress *(0.1-0.49)*	46	52.3
Partial stress *(0.5-0.99)*	34	38.6
Total	**88**	**100**

V. CONCLUSION AND RECOMMENDATIONS

The water stress situation in the communities selected in Guyuk local government area is as severe as majority of the households have been proven to be water-stressed using the UN minimum standards of 50 litres of water per capita per day. This has driven people into a condition of desperation to search for water from unimproved sources thereby exposing them to diseases. There is the need for a deliberate and drastic measure to save the people from plunging further into problems arising from water related sicknesses that are common in the area. This research has exposed how much water deficiency can affect people and therefore will attract assistance from National and International organisations with interests in tackling water supply problems. It is highly recommended that Rainwater Harvesting (RWH) plan should be developed and encouraged to ease domestic water stress in the area and to ensure the use of environmental resource in a sustainable way for a sustainable livelihood. This planning strategy will involve rainfall studies, households' water requirement and consumption so as to determine the size of tanks that will be appropriate for each household to store water for use especially during the dry season when the water stress worsens in the area.

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