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Influencing Factors of Household Water Source in Khulna City

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ABSTRACT

In order to select, water-source household considers some factors that influence 'resource-constrained households' decision-making. It is surprising that after the MDGs and going on SDGs still face challenges in the case of reaching accessible and affordable water for everyone among the people of developing countries. However, groundwater serves as the main source of water in Bangladesh , now a days bottle water, pipe water provide by WASA (water and sewer authority) widely used as popular drinking water source. This paper explained the background factors that were associated with household water source. Here for the study up to 22 years old household head (n=199) from three different wards of Khulna were the respondents. The data were collected through face-to-face interview and in-depth interview with the help of a semi-structured interview schedule. Multinomial logistic regression and thematic analysis helped to analyze the data. The study is only limited to Khulna city, which was a hindrance to get proper information because the practices and demographics vary from place to place. The results found a significant association between water source and socio economic and demographic factors like income, gender, education, dwelling status. The study shows that comparatively high earning people preferred pipe water and submersible pump having chi-square 7.947 (<0.05). This study clearly summarized that the association between water source and household factors. According to the study,78.9% female were collected water for their family. In addition, qualitative part summarized various problem related with water source.

Keywords: Water supply, Drinking water, Socio-economic status, Sanitation ladder, Water purifier

1. Introduction

From prior to creation water is an unalienable thing for human being. It is a natural resource that is an unavoidable part for human life (Adapa, Bhullar, & de Souza, 2016). Nevertheless, water affordability is troublesome issue of meeting global household water need. Since 2000 the Millennium

Development Goals, and after that the Sustainable Development Goals have directed to achieve global water security(WHO/UNICEF, 2017).Sustainable Development Goal 6.1 is aimed "To achieve universal and equitable access to safe and affordable drinking water for all". Hereafter lack of access to safe water for low- and middle-income householdis considered as one of the momentous problem especially in developing countries(Huq, Holvoet, & Huq, 2020).Sources of drinking water play a ticklish role in ensuring sustainable development (Nauges, 2010).An approach named "Coping Cost" has been obtained for measuring the access of clean water in household(Amit & Sasidharan, 2019).

Having access to potable water facility is considered as a global challenge even in 2020 (WHO, 2015).The theory of "Constrained Utility Maximization" can narrate household decisions making behavior by considering risk-mitigating behavior. According to this theory, household incomes and resources are limited,that household have to consider budget constraint method. Household has to make rational choices among alternative goods and trying to get the most value from its' limited money.In this case, aprovince of factors as household risk preferences, cost, knowledge, and behaviors along with external actors like political instability, demand raising, price hiking influence the decision (Dupas, 2011).

By considering wealthy countries like (USA, Canada, Japan) water use pattern, we have come to know that they use multiple sources of water (Foster & Hope, 2016). But even now there are so many challenges to get potable water and improved sanitation facility in developing countries (Cosgrove & Rijsberman, 2014). Household choice of drinking water sources has significant health and socioeconomic development implications (Ismaila Rimi & Umar Lawal, 2018).There are still challenges to get potable water influenced by socioeconomic, and demographic factors such as income, house quality, education, household size, (Keshavarzi et al., 2006).Progress had seem in 2017 when almost 47.7% of the rural population accessed to drinking water with treatment and 41.6% accessed to protected well or spring water in Bangladesh(National Bureau of Statistics, 2018). Nearly 19% of urban slums households in India have access to piped water(UNICEF/FAO/SaciWATERs, 2013).In the case of South Asian, developing countries may have enjoyed pipe water service on average 7 hours per day (Kumpel & Nelson, 2016). Bangladesh achieved tremendous progress in water facilitation from 1990 to 2015 it position sifted from 79 to 98 in improved water facility where the results showed that India, Sri Lanka scored 94, 96. In this, sectors Bangladesh leads the second position in Asia (WHO/UNICEF, 2015).

Table 1-Progress of drinking water in Asia

Country	Total improved water	
	1990	2015
Bangladesh	79	98
Bhutan	72	100
India	71	94
Nepal	66	92
Pakistan	86	91
Sri Lanka	68	96

Source: WHO/UNICEF, 2015

Bangladesh's journey with water has been teeming with enormous challenges. In the past lion's share of Bangladesh's population obtained their drinking water from surface water sources (ponds and rivers). In the 1970s, UNICEF led a campaign to promote tube-wells across the country. As a result, by the early 1990s, this campaign was flourishing

and millions of shallow tube-wells that pulled up water from shallow aquifers were installed especially in rural areas of Bangladesh. This initiative was able to provide drinking water for more than 90 percent of the total population in the country. However, this success had a major threat there was an increasing number of people diagnosed with symptoms of arsenic. Much effort has been taken at the implementation level by arranging deep tube-wells and other arsenic-free safe water options by the government and various NGOs such as BRAC, Water Aid (Islam, 2017).With a rapidly growing economy and an expanding middle class in Bangladesh, urge the demand for piped water services within premises both in urban and rural areas. Nevertheless, piped water supply can be termed sluggish in this country and report showed that only about 10 percent of the total population has access to piped water while urban and rural areas pipe water supply cover only 30 percent and 2 percent, respectively (Local Government Division, 2011).

Fig.1 BRAC WASH programme scale of water provision

Not only Khulna is one of the seven administrative units division in Bangladesh but also it is the third largest city in the country (Bangladesh Bureau of Statistics, 2015).In spite of being associated with river and water bodies;households, industries, and agriculture of Khulna largely depend on groundwater source. Municipal water supply is not sufficientand household tries to fill this gap with the help of private abstraction of water(Shivakoti, 2016). Khulna is a land of large number of water body in early stage of the independence of Bangladesh people used to collect water from surface water sources as time changes the city used to adapt to sallow tube-wells but there were severe arsenic and salinity problem in this region. In this regard, people tried to build up borehole or deep tube-wells and pipe water sources as time changes. Because of population growth Khulna Water Supply and Sewerage Authority (KWASA) covers only 24 percent of its residents with improved pipe water facility (Islam, 2017).

However, household makes the choice of water source in based on water security. The lack of safe and adequate water for drinking, bathing and other household task are a threat to health. Having with high quality water infrastructure in urban residents in Bangladesh, generally household can make choice among sources of drinking water: borehole, pipe water, and bottle water. We have multiple sources of water especially in urban area. In this regard, this study started with the view that how household makes choice of their water sources. What kinds of factors are responsible for selecting a specific water sources in Khulna area. Aim of this

study was to examine the factors influencing household choice of water source.

2. Method

2.1.Study Design

Both qualitative and quantitative methodshad been used to avail the research objective. In the qualitative part, the research tried to explain why this happened. Descriptive technique used to describe the nature and trend of water use. Multinomial logistic regression analysis used to assess the relationship between dependent and independent variables. In qualitative part, thematic analysis used to express the condition of the water use perception of the study.

2.2.Study Area

This study was conducted on Khulna City Corporation with an area is 40.79 sq. kilometer. It is located in between 22˚49′ to 22˚54′ north latitudes and between 89˚28′ to 89˚35′ east longitudes (Hassan, 2017). In this study based on specifically in 24, 25, and 26 no wards of Khulna CityCorporation.

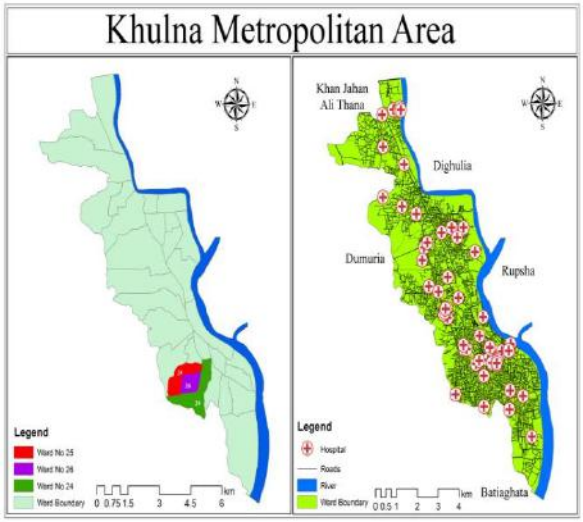

Fig.2 Map of the Study Area

Source: Banglapedia, National Encyclopedia of Bangladesh, 2011.

2.3.Study Population

The study population was household head who had influenced to determine household water choice and decision making in the household.

2.4.Sample Procedure and Sample Size

For this study sample was collected from 24, 25 and 26 number wards by using the purposive sampling technique. Here the total population was 7456 for the study.For sample size determination, this study followed the simplified formula that was given by Yamane (Yamane, Wyluda, & Shulman, 1967). This formula was used to calculate at 93% confidence level and P= 0.07 is assumed for equations. The total respondents of the study area were 7456. By using this formula, the sample size was 199 household head.

2.5.Data Collection and Research Instrument

For conducting the study, data were collected not only from primary source but also from secondary source. Primary source included the field survey. A semi structured interview schedule with both open and close-ended questions through face-to-face interviews and in depth interviews were used for data collection. Observation survey method was also used for collecting data. Secondary data had been collected from different research articles, journals, government document, policy paper, internet document and so on.

2.6.Dependent and Independent Variables

The household drinking water source is the dependent variable for this study which has three different categories which are in below,

$$Y = \begin{cases} \text{if the household used Pipe water for drinking water source} \\ \text{if the household used Borehole water for drinking water source} \\ \text{if the household used Bottle water for drinking water source} \end{cases}$$

Independent variables for this study were income, water access, water collection, purifier use, dwelling type, family type, carrying payment.

2.7.Statistical analysis

Statistical analysis of this study was conducted with help of Microsoft excel 2016 and IBM SPSS 20. Chi-square test ($\chi 2$ of Pearson's through p-value) also regarded as the bivariate analysis was used to evaluate and check the association between the dependent and independent variables. Univariate analysis was used to perceive frequency distribution and Multinomial logistic regression analysis was conducted to identify the relationship between dependent and independent variables where the correlation between categorical variables was determined for this study(Agresti & Kateri, 2011). A general model introduced by (Fu, 1998)was used for this study, written in bellow,

$$P(Y_i > J) = g(X\beta_j) = \frac{exp(a_j + INDVAR_i\beta_j)}{1 + \exp(a_j + \text{INDVAR}_i\beta_j)}, J = 1,2, \ldots . M - 1$$

Here *M* represents categories of ordinal dependent variable.

$$P(Y_i = 1) = 1 - g(INDVAR_i\beta_1)$$
$$P(Y_i = 1) = g(INDVAR_i\beta_{j-1})$$
$$P(Y_i = M) = g(INDVAR_i\beta_{j-M})$$

3. Result

3.1.Univariate Analysis

Having various access to drinking water facilities each household chose one source based on economic and household capability. In this study drinking water sources were categorized into three different levels i.e pipe water, borehole water and bottle water.

The results of descriptive analysis revealed that 30.2%, 44.7%, and 25.1% household respectively used pipe water, borehole water and bottle water. In terms of attributes 49.2% nealy half of the respondents belonged from rich or middle income family.70.4% of household used distance water source. Female has a close affinity with water collection i.e female water collection rate was 78.9%. This study pointed out that 73.9% of the total respondents used purifier for cleaning their drinking water. Most of the respondents i.e 65.3% were temporary dwellers,32.2% were nuclear family and 81.4% househod had to pay money for carring water.

Table 2 – Frequency distribution

Variable types	Variables Name	Variables Category	Frequency	Percentage
Dependent		Pipe water	60	30.2
	Water sources	Borehole water	89	44.7
		Bottle	50	25.1
	Income	High/middle income class	98	49.2
		Lower income class	101	50.8
	Water access	Distance	140	70.4
		Premises	59	29.1
	Water collection	Male	42	21.1
		Female	157	78.9
	Purifier	No	52	26.1
Independent		Yes	147	73.9
	Dwelling type	Permanent	69	34.7
		Temporary	130	65.3
	Sanitation ladder	Unimproved	42	21.1
		Improved	157	78.9
	Family type	Nuclear	64	32.2
		Extended	135	67.8
	Carrying payment	Yes	162	81.4
		No	37	18.6

3.2.Bivariate Analysis

It was seen in Table 3 that the pervasiveness of water source was impacted by various factors. Income was significantly associated with water source use, the value of chi-square was 7.947 ($p<0.05$). The association of water access (premises, distance), the gender of water collection and type of dwelling with respect to the water source patterns were highly statistically significant having the value of chi-square 17.594 ($p<0.0001$), 29.269 ($p< 0.0001$) and 15.205 ($p<0.0001$) respectively.

Table 3 – Water sources and their association between selected predictors

Variable	Variable Category	Water Source			Pearson's Chi-Square
		Pipe water	Borehole water	Bottle water	$\chi 2$ (P)
INCOME	Rich/Middle income family	16.6%	24.6%	8.0%	7.947 (<0.05)
	Poor income family	13.6%	20.1%	17.1%	
Water access	Premises	14.1%	13.1%	2.5%	17.594 (<.0001)
	Distance	16.1%	31.6%	22.6%	

Water collection	Male	3.0%	6.0%	12.1%	29.269 (<0.0001)
	Female	27.1%	38.7%	13.1%	
Purifier	No	6.0%	8.5%	11.6%	13.673 (<0.01)
	Yes	24.1%	36.2%	13.6%	
Dwelling type	Permanent	13.1%	18.6%	3.0%	15.205 (<0.0001)
	Temporary	17.1%	26.1%	22.1%	
Sanitation ladder	Unimproved	2.5%	10.6%	8.0%	9.774 (<0.01)
	Improved	27.6%	34.2%	17.1%	
Family type	Nuclear	10.1%	19.1%	3.0%	13.881 (<0.01)
	Extended	20.1%	25.6%	22.1%	
Water Carrying payment	No	4.5%	12.1%	2.0%	8.341 (<0.05)
	Yes	25.6%	32.7%	23.1%	

The chi-square was 13.673 ($p<0.01$) in purifier use with water sources pattern. There was a statistically significant relationship between sanitation ladder and water source pattern with chi-square value 9.774 ($p<0.05$). Similarly, the family type was significantly associated with the water source with chi-square 13.881 (<0.01). In conclusion, Water carrying payment and water source were significantly related having chi-square value 8.341 ($p<0.05$).

3.3.Multivariate Analysis

The likelihood chi-square statistic for this model was 126.989 with 16 degrees of freedom and the result was highly significant [$\chi2(16)=126.989$, $p<0.0001$]. Table-4 represents there was highly significant relation in water access, water collection, dwelling type, purifier use, sanitation ladder, and family type, in contrast, no relationship in income and water carrying payment in the case of pipe water use, where the coefficients showed the likelihood of using the pipe water source and borehole water source compared to the bottle water source. In borehole water, there was a highly significant association in water collection, and dwelling type similarly significant association in income, water access, purifier, family type and water carrying payment, conversely no significant relationship found in sanitation ladder in the borehole water source.

Table 4 - Multivariate Analysis

	Factors	B	Significance	OR (95% CI)
Pipe water	**Water access**			
	Distance	3.247	0.000<0.0001	25.705 (5.845–113.043)
	in premise (ref)			
	Water collection			
	Male	-3.278	0.000<0.0001	0.038 (0.009–0.165)
	Female (ref)			
	Purifier			
	No	-1.575	0.010<0.05	0.207 (0.063–0.681)
	Yes (ref)			

	Dwelling type			
	Permanent	3.275	0.000<0.0001	26.433 (6.065–115.209)
	Temporary (ref)			
	Sanitation ladder			
	Unimproved	-2.172	0.004<0.010	0.114 (0.026–0.494)
	Improved (ref)			
	Family type			
	Nuclear	1.875	0.008<0.010	6.518 (1.618–26.251)
	Extended (ref)			
	Income			
	High/middle class	1.153	0.035<0.05	3.166 (1.085–9.242)
	Lower class (ref)			
	Water access			
	Distance	2.442	0.001<0.010	11.497 (2.743–48.200)
	In premises (ref)			
	Water collection			
	Male	-2.826	0.000<0.0001	0.059 (0.016–0.217)
	Female (ref)			
Borehole	**Purifier**			
	No	-1.555	0.006<0.010	0.211 (0.070–0.634)
	Yes (ref)			
	Dwelling type			
	Permanent	3.061	0.000<0.0001	21.344 (5.288–86.156)
	Temporary (ref)			
	Family type			
	Nuclear	2.313	0.001<0.010	10.102 (2.675–38.147)
	Extended (ref)			
	Carrying payment			
	No	2.096	0.006<0.010	8.133 (1.843–35.886)
	Yes (ref)			

The reference category is Bottle water
Level of significance (.05)

Distance water access compared to that of premise was 25.705 times more likely to be used for pipe water than bottle water (OR=25.705, 95% CI=5.845–113.043). Most of the time female collected water for their family, male compare to female was 96.2% less likely to collect pipe water than bottle water (OR= 0.038, 95% CI= 0.009–0.165). Households not using purifier compare to using purifier were 79.3% less likely to go for pipe water than bottle water (OR= 0.207, 95% CI= 0.063–0.681). Permanent dwellers were 26.43% times more likely to use pipe water than bottle water (OR= 26.433, 95% CI= 6.065–115.209). It was observed that household with improved sanitation ladder facility was more likely to use pipe water. Having unimproved sanitation ladder

facility compare to that of improved were 88.6% less likely to use pipe water than bottle water. Nuclear families were 6.518 times more likely to go for pipe water than bottle water compared to extended family (OR= 6.518, 95% CI= 1.618–26.251).

High and middle-class families compare to lower class families were 3.166 times more likely to go for borehole water than bottle water (OR= 3.166, 95% CI=1.085–9.242). It was observed that distance water access compared to that of premises was 11.497 times more likely to be used borehole water than bottle water (OR= 11.497, 95% CI= 2.743–48.200). Male water collection had lower odds of using borehole than bottle water compared to female (OR= 0.059, 95% CI= 0.016–0.217). However, households using purifier were 78% less likely to use borehole than bottle water compared to households not using purifier (OR= 0.211, 95% CI= 0.070–0.634). Permanent dwellers were more likely to use borehole water (OR= 21.344, 95% CI= 5.288–86.156). Nuclear families compare to extended families were 10.102 times more likely to go for borehole water than bottle water (OR= 10.102, 95% CI= 2.675–38.147). Not having water carrying payment possibility was 8.133 times higher in borehole water than bottle water compared to having water carrying payment (OR= 8.133, 95% CI= 1.843–35.886).

3.4.Thematic Analysis

Maximum of the respondents were responses about their household water access and its various problems and prospectus.

3.4.1. Water and Women

Maximum respondents stated that, this was a duty for women to collect water according to the social perspective.However, few respondents addressed that the situation is now changing because of women involvement in job sector and male member of the familyare aware of helping them in a cooperative manner.

(According to respondent)

Respondent 04 (59 year's old, businessperson): There is an obvious relationship between women and water. Women are associated in handling household work along with their professional life.

Respondent 197 (45 year's old, homemaker): It is a duty for women to collect water, as she is a homemaker.

3.4.2. Time and Water

Almost half of the respondents stated that water limited collection time affected their daily life in various way.

Respondent 44: (35 years old, government Job-holder): Water collection time was affected normal life in significant manner.

Respondent 92: (52 years old, house cleaner): It is too difficult to balance between household water collection and time expending and cost because water in premise cost more for the family.

3.4.3. Water and Odor

In 26 no ward some people avoided the nearest public borehole water for the odor of the water. However, in some cases some respondents used to drink this because of shortage of time.

Respondent: 32(37 year's old, banker): the water in the nearest water source is good in drinking but slightly odor come out from that. We had to paid more to collect water from distance source.

Respondent: 54 (32 year-old, private job holder): Because of the odor of the water my wife has to go for a distance source, many an time she fails to

manage her work for the serial of water collectors or if she goes late.

3.4.4. Water and Sanitation Ladder

If there is an availability of sanitation ladder then it is obvious to have pipe water line or in case of permanent dwelling the dwellers used to use submersible pump and the water carried by sanitation ladder depend on their own economic condition.

Respondent 28 (42 years old, private jobholder): As I am a temporary habitant here, I use to use submersible provided by house owner and there is a good quality of sanitation ladder. Respondent 67 (36 years old day labor): There is no good facility for sanitation ladder I along with 12 householders were used water from one tape which was provided by the owner of the place and many a times we had to straggle and sometimes argued for the water.

4. Discussion

Through this section, we have come to know a discreet translation of our primary findings.The study analyzedthe sociodemographic factors associated with access to improved water in southern part of Bangladesh. The study is consistent with other studies as (Koskei, Koskei, Koske, & Koech, 2013; Obeng-Odoom, 2012).Our findings indicate that water management system depended on social and economic costs. Regardless of consumers, socio-economic status cost was a major concern to all. Also(Banerjee, 2011)suggested that this trend almost same across country. Based on the findings of the study and responses, most of the middle-income group residents have the capability to pay for water supply in their house they were 3.166 times more likely to use borehole water service. Although having improved facility of drinking water service only 29.1% residents could enjoy drinking water service in their home premises. It required more money to have a good water access on premises. Only 14.1% of the respondents who have improved water infrastructure and having pipe water service in their own house can enjoy the facility. In addition, 13.1% residents have borehole for their house in premises. In contrast, 16.1% pipe water users had to go distance for collecting water from community based pipe water service and 31.6% residents collect water from public borehole water.Improved water supply cannot possible to meet without dealing with the challenges. Rural and suburban areas need improving funding for water access. Proper management and more capital allocation are still required for building sustainable water infrastructure in Bangladesh (Angoua, Dongo, Templeton, Zinsstag, & Bonfoh, 2018)reported that same situation in Nigeria.In most of the cases the Poor people in this country not having the proper water facility in their house premises. This may be due to socio-economic and cultural differences(WHO/UNICEF, 2015; Wutich, 2009).Both qualitative and quantitative part of the study represented that female has a close relation with water collection more specifically in develping countries context women and girls are recognised as primary stakeholders in household daily activities as oppose to men. In this study findings 78.9% case female used tofetch water for their family. The condition is in line with other studies(Garcetti & Kevany, 2013). Thematic analysis reveals that, time has a great influence factor in case of water access. Based on time household used to choose water sources for their household. Households have access to water improved sources of water, while majority of the households are obtaining water within the maximum of 30 minutes. This affiliation resulted

the same in the study of (Mahama, Anaman, & Osei-Akoto, 2014).

However, females are not usually considered as equals to males in participating in water governance in thematic analysis response showed that in decission making male member has the priority over female in water source selection. This situation is also reflected in(Das, Duiven, Arendsen, & Vermeulen, 2014) study. 73.9% households used purifier to make the water clean. The chi-square value is 13.673 and a highly significant association established in purifier use and water source. The relationship shows that connection of piped water, public standpipe, and borehole set up with the influence of residential status. Results indicate that 30.7% of permanent dwellers used pipe and borehole water in their house. Temporary dwellers had the tendency of taking bottle water source about 22%, temporary residents used to take bottle water. Indeed improved sanitation facility depended on household income. In this regard, the household can afford adequate sanitation facility; it corresponds to higher likelihood of having access to better domestic water source. Pipe water facility has a close association with improved sanitation. Residents with unimproved sanitation facility were 88% less likely to have pipe water. In the study 21.1% household hadunimproved sanitation ladder facility for their household.Furthermore, nuclear household tended to use pipe and borehole water facility compare to bottle water in the study we found the ratio of nuclear and extended family is 32.2% and 67.8%. Because of featching water from distance water source rich or middle-income family used to pay watter carrying payment 81.4% households were bearing the cost of water carrying. We found almost same attitudes in the study of (Irianti, Prasetyoputra, & Sasimartoyo, 2016).

5. Conclusion

This study showed various sources of water and its factors. It also clearly infers the association of these factors in various manner. Household head respondents were stated that their condition of their household water. In addition, how and why they are using this and how they were able to choose the water source for their house. In some cases, it is now challenging to meet sustainable water source so step should take about this issues. Almost all of the respondents were state that this is a duty for women to collect water as a mother, wife, sister, and girl. In context of Bangladesh, female are doing household work. Furthermore, dwelling status has a close relation with water source. Gender of household head also influenced in decision making about household water source. Adequate quantifying infrastructure provision should be included in quality and affordability of services. In this regard, these factors should be inculcated in a universal definition of improved access to water, so household water sanitation also influences the water source. As now sustainable water is going to ensure in Bangladesh these kinds of factors should be consider as vital issues though this path.

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