

Consumption behavior of water: A case study of Chittagong City

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Abstract

Chittagong is second largest city in Bangladesh with huge population and heavy industrial areas. Due to high population and industrial activities water requirement is increasing day by day. Sufficient quantity and required quality of water is a major concern for drinking and other purposes for the city dwellers. Inadequate quantity and poor quality of water is a major problem in this city. The present water supply system of Chittagong City Water Supply and Sewerage Authority (CWASA) is not appropriate for the city dwellers. There is neither supply of water for all the people from CWASA nor have sufficient number of safe, salt-free and reliable sources of water in Chittagong. This study investigates the present water consumption behaviour in Chittagong city. There have 41 wards divided by Karnafuli river. One part is busy city area and other part is heavy industrial area. A questionnaire survey was conducted in the study area of Chittagong city for collecting necessary data. The questionnaire survey form was prepared based on some important characteristics of the city dwellers. About 9 major wards and a total number of 400 persons were interviewed in Chittagong City Corporation (CCC) area. The main objectives of this study are to investigate different available sources of water, survey the trend of the city dwellers for selection of water sources for different household chores, investigate the diseases and inconvenience they face while using the available water in Chittagong. The arranged and sorted out data were analysed by Service Product for Statistical Solution (SPSS) software to establish relationships among dependent and independent variables by linear regression, cross tabulation and correlation analysis. Finally, a bunch of suggestions was provided to fulfil the water supply necessity of the city.

Keywords: Water Consumption, questionnaire survey, linear regression, cross tabulation

1. Introduction

‘Water is life’ this is known to us. Water only can save us in the world. For human welfare and economical activities, domestic fresh water is a fundamental requirement. Human survival and welfare generally depend on regular availability and control of water. The paradox of community water supply in developing countries is that everyone has access to water supply, however in fact many people do not. They may access to water, but only a large walking distance, in too little volume or of poor quality. A lot of effort is made in the world to change this situation; however is this situation really changing?

It is very important to study the consumption behavior of water. The water consumption pattern is a very important parameter generally used in estimation of water consumption in a certain periphery. The amount of consuming water needed daily, depends on various factors such as temperature, gender, region, community pattern, stage of production, health, etc. Information on the water consumption pattern of a population is essential in order to estimate the risk of adverse health effects attributable to any water contaminant. It is also crucial in developing a safe water supply program for a population. As a common characteristic of the urban areas of Bangladesh, accessibility to the suitable quantity and quality of water is a major problem in the city areas of Chittagong. Unplanned and improper withdrawal of water is the main reason of the shortage of water. These shortages become more acute during the dry seasons. The ground water withdrawal and recharge can be increased, approaching the potential limits by creating additional storage through increased during dry season

(Ahmed and Rahman, 2000). People in these areas are in such condition that they neither have a supply of water from Chittagong Water Supply and Sewerage Authority (CWASA), nor have sufficient number of safe and reliable sources of water in their surroundings. There is also less availability of sources that provides salt-free water in Khulna city areas (Mohsin, 2007).

The greater Chittagong region is very close to the Bay of Bengal. Due to the geological position of Chittagong, the water in the ground exhibits high salinity. There is a scarcity of water even for drinking and in the city areas of Chittagong people are sometimes bound to use the saline water for drinking and household purposes as the non-saline water they get from surrounding sources is not sufficient to meet their demand. The consumptive use of saline water causes lots of inconvenience to the users. The augmentation of salt water in the surface waters increases the abstraction of groundwater, which then becomes vulnerable to a risk that salt water will be drawn into the aquifer (Md. M. Rahman & A. K. Bhattacharya, 2006)[3]. There are some people who are in better economic condition and well educated are using water from alternative sources for drinking, whereas a lot of people are beneath the poverty line and some people are not well aware of health and hygiene are using the water they can collect from the nearby water sources. It is a matter of great concern that there is no water supply in the city areas of Chittagong. That is why the water consumption pattern analysis is necessary to find the quality and quantity of water people are using for different household purposes.

2. Objective of the study

The social status, economic conditions, level of education, age and experience of people are the factors affecting the selection of sources for water. Availability of fresh water is another factor that has significant influence on it. Factors affecting higher probabilities of a respondent being primarily a bottle water drinker included: higher income, unpleasant taste experiences with tap water, non French-speaking and being a male with children in one's household (Dupont et al., 2010). The objectives of the study are:

1. To investigate of different available sources of water in the city areas of Chittagong.
2. To survey the local people about their selection of water sources for different household uses.
3. To investigate about the disease and the inconvenience they face while using the available water.
4. To find out the correlation between the awareness of people while choosing a source of water and the occupation, experience, authority, maturity, gender, socioeconomic condition, level of education of local people using the SPSS (Statistical Package for the Social Sciences)
5. To analyze the change of trends in the selection of water sources with the changes of the influencing factors.

3. Methodology

The methodology of this study includes:

1. Collection of Information: Information has been collected about the existing condition of sources of water in the areas of CCC, the required information was provided by Chittagong WASA.
2. Preparation of a Questionnaire Survey Form: A questionnaire survey form has been prepared, including all the inquiries required for the analysis of this study.
3. Questionnaire Survey: Surveys of local people have been performed to collect the required data. The survey was performed based on the factors influencing people's selection of water sources. 200 participants were surveyed from the study areas.
4. Data Sorting: The collected data have been arranged and sorted out for the analysis.
5. Analysis: The analysis for determining the correlations have been done by SPSS 16.0 software through the linear regression analysis method. The correlation matrix is formed by a Bivariate correlation method with Pearson correlation coefficients.

4. Study area

The study area is very important in this study. This study is not based on a particular area in Chittagong city. The areas are selected from the different wards, so that it focuses on the whole city area. The research work is to be carried out in Chittagong city as shown in Table 1.

Table 1: Study area of Chittagong city

No	Ward No	Name of the Area
01	4	Chandgaon
02	5	Mohora
03	6	Shulashohor (North side)
04	33	Firingi Bazar

05	34	Pathorghata
06	35	Boxirhat
07	39	South Haliashahar
08	40	North potenga
09	41	South potenga

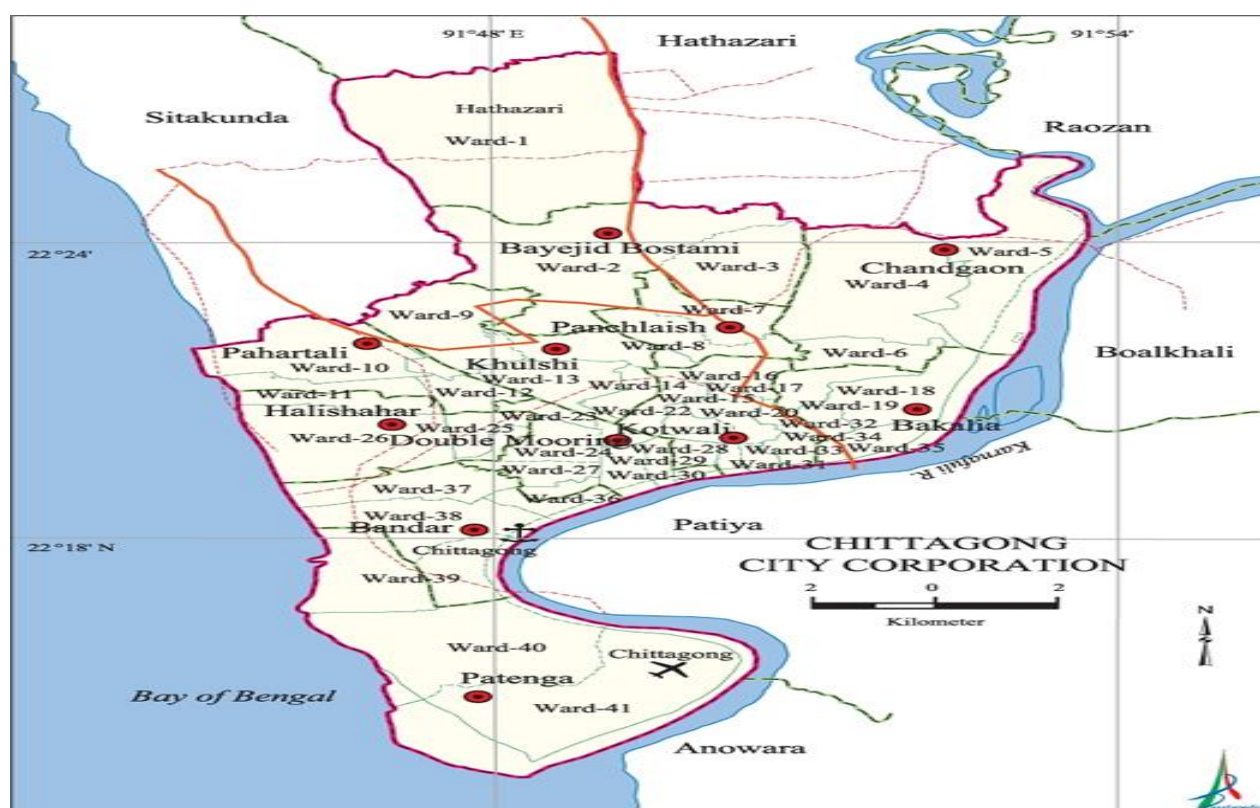


Fig.1: Ward plan of Chittagong city

5. Factors influencing people's selection of water sources

Although the human mind and the choice are unique, there must be some factors that have an influence on the selection of water sources for different uses. Availability of proper water source come in the list. The factors are age, gender, occupation, economic condition, authority, family members, level of education.

6. Result and Discussions:

6.1 Regression analysis in drinking water sources

The output of the model (SPSS software) for drinking water sources are shown in Table 2 and Table 3.

Table 2: Model summary of drinking water sources

Model	r	r ²	Adjusted R square	Std. Error of the Estimate
1	0.523 ^a	0.274	0.210	0.7191

a. predictors: (constant), physician cost (PC), detergent (D), color (C), family members (FM), education(E)

Coefficient of Correlation, $r = 0.523$

Coefficient of determination, $r^2 = 0.247$

Table 3: Coefficients of drinking water sources

Model		Unstandardized Coefficient		t	Sig.
		B	Std. Error		
1	(constant)	2.216	0.324	5.702	0.000
	Family members	-0.319	0.082	-4.341	0.000
	Detergent	0.254	0.113	2.342	0.025
	Color	0.523	0.123	5.291	0.000
	Education	-0.156	0.045	-3.097	0.004
	Physician cost	0.172	0.072	2.456	0.034

a. dependent variable: drinking

The equation formed by the co-efficient is given by

$$\text{Drinking water source} = 2.16 - 0.327*(FM) + 0.244*(D) + 0.536*(C) - 0.150*(E) + 0.165*(PC) \quad (1)$$

The results from the Eq. (1) will near 2. In the most cases, as 1 represents the water source is a tap water and 2 denotes the water source is a tube well. For a particular household for which the participant's family members is 2-4 (1), detergent (1), color (1), education graduate(6), physician cost 100-500(1); the result of drinking water source becomes 1.978 which means the household uses a tube-well water for drinking.

6.2 Regression analysis in main water sources

The output for main water sources are shown in Table 4 and Table 5.

Table 4: Model summary of main water sources

Model	R	r ²	Adjusted R square	Std. Error of the Estimate
1	0.601 ^a	0.361	0.382	0.37432

a. Predictors: (constant), Detergent(D), Color(C), Family members(FM), Diseases(Di), Red(R)

Coefficient of Correlation, $r = 0.601$

Coefficient of determination, $r^2 = 0.361$

Table 5: Coefficients of main water sources

Model		Unstandardized Coefficient		t	Sig.
		B	Std. Error		
1	(constant)	2.112	0.157	12.657	0.000
	Family members	0.154	0.034	3.918	0.000
	Detergent	-0.411	0.051	-7.967	0.000
	Red	0.079	0.017	3.975	0.000
	Diseases	-0.062	0.015	-3.250	0.001
	Color	-0.156	0.051	-2.292	0.023

a. Dependent Variable: main sources

The equation formed by the coefficient is given by

$$\text{Main water source} = 1.952 - 0.134*(FM) - 0.410*(D) + 0.69*(R) - 0.048*(Di) + 0.116*(C) \quad (2)$$

The results from the Eq. (2) will represent whether the household selects a tube-well water source or tap water as their main source. If the value of the equation is closes to 1, it will indicate the tube-well and, if the value is close to 2 it will indicate tap water as their main sources. For a particular household for which the participant's family members 2-4 (1), detergent (1), red (1), diseases (1), color (1); the result for main water source becomes 1.241 that is closer to 1 which means the main water source is tube-well.

6.3 Percentile selection about consuming water

The selection of different water sources is shown in Table 6.

Table 6: Selection of water sources

Water Sources	Drinking		Cooking		Bathing and Washing	
	Frequency, f	Percentage, %	Frequency, f	Percentage, %	Frequency, f	Percentage, %
Tube-well	159	79.5	120	60	138	69

Filtrate water	40	20	0	0	0	0
Bottle water	1	0.5	0	0	0	0
Pond/river	0	0	3	1.5	9	4.5
Tap water	0	0	77	38.5	53	26.5

The selection of medicine and physician cost per year for different diseases are shown in Table 7.

Table 7: Selection of medicine and physician cost per year for suffering diseases

Diseases	Frequency, f	Percentages, %	Average cost per year (TK)
No diseases	95	47.5	1100
Dysentery	100	50	
Diarrhea	5	2.5	

7. Education and drinking cross tabulation

Table 8: Variation of drinking water source with education level

Count		Drinking			Total
		Tap Water	Tube well Water	Filtrated water	
Education	Only signature	4	5	0	9
	Primary	1	5	3	9
	SSC	0	28	10	38
	HSC	0	41	9	50
	Graduate	0	79	15	94
Total		5	158	37	200

The variation of drinking water sources with education level is shown in Table 8. Some survey participants below SSC use tap water for drinking purposes. But the educated people (HSC and graduate) use tube well water and filtrated water for the drinking purposes. The more education level is increased, the more people are interested in using filtrated water as shown in Table 8.

8. Correlation matrix of dependent and independent variables

The relationship between dependent and independent variables are shown in Table 9. The Correlation between two variables represents how the variables are related to each other and in which way one variable will respond to any change of the other. The optimistic value of correlation is 1. If correlation is greater than 0.5 then the relation between two variables is considered better.

Table 9: Correlation matrix

Variable	1	2	3	4	5
1. Age	.081				
2. Gender	.41	1			
3. Occupation	.574	.402	1		
4. Economic condition	.176	.193	.236	1	
5. Family members	.071	.051	-.10	.193	1
6. Education	.151	.076	.089	.222	.308
7. Drinking water source	.115	.209	.164	.033	.292
8. Cooking water source	.058	.163	.019	.097	.145
9. washing water source	.11	.177	.044	.104	.081
10. Amount of drinking water	.037	.059	.207	.052	.137
11. Taste	.254	.100	.079	.002	.251
12. Regularity	.041	.017	.030	.067	.065
13. All seasons	.074	.132	.161	-.11	.023
14. Diseases	.074	.025	.270	.195	.198
15. Satisfaction	.087	.158	.105	.038	.008

