

## AN ASSESSMENT ON WATER SUPPLY, SANITATION AND WASTE MANAGEMENT IN SLUMS OF DHAKA CITY

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### ABSTRACT

A slum is an adjoining settlement which grows haphazardly in an unwholesome condition and where the residents are characterized as having inadequate housing and basic services. Cities are being flooded with people looking for a job and a decent income. The City of Dhaka is not an exception to it. The paper reports on the condition of basic services such as water supply, sanitation and waste management in slums of Dhaka City. A vast majority of people having no other places to go, then ends up in the squatter settlements and slums sprawling within the City. This study was undertaken to assess the present scenario of the number, structure and housing condition of slum, nature of slum people, income patterns, and water supply at community or household level, thorough behavioral practices in sanitary and waste disposal systems in the slums of collected sample from selected locations. The study was conducted to get an external evaluation of the effectiveness of the basic services-water supply; sanitation practice and waste management system of slums are situated in Dhaka city. For this, 10 slums of Dhaka city has been represented in this paper by analyzing the census and survey report. The conditions of the slums are analyzed using T -test, F-test and Z-test and nonlinear regression analysis. The study ends up with the decision that the conditions of the service facilities are not adequate in the slums of Dhaka city and a lot of works need to be done to improve the facilities for making the slums in shape for the dwellers habitation.

**Keywords:** Dhaka, Regression analysis, Slum, Sanitation, Water supply, Waste Management

### 1. INTRODUCTION

Dhaka is the largest city of Bangladesh. Slum population has been largely increased in Bangladesh over the last three decades along with the expansion of cities and towns. Urban population of Dhaka city are continuing to increase, especially poor sections of the population, mostly girls and women who seek jobs in garment factories, the Dhaka Export Processing Zone (CEPZ) and other industries ending up living in slums. Water supply and sanitation facilities in terms of quality and quantity are utmost necessary for assessing the living environment of the slum. In many areas the sanitation coverage is much below than that of the national coverage figure, According to Center for Urban Studies it's only 13.5% in metropolitan slums (Town, 2009). Waste management in different slums is very poor indeed. Environmentally sound waste management must go beyond the mere safe disposal or recovery of wastes that are generated and seek to address the root cause of the problem by attempting to change unsustainable patterns of production and consumption. This implies the application of the integrated life cycle management concept, which presents a unique opportunity to reconcile development with environmental protection. Each day Dhaka city is producing over 3000 tons of households waste (Islam K. H., 2001). On the other hand Dhaka City Corporation collects almost less than half of it (Chowdhury, 2006). The rest remains on roadsides, open areas. So, most of urban bodies are finding it very difficult to keep pace with the demand for adequate solid waste management. It will become very difficult to find sites to bury the waste as the city expands, and transport costs to transfer the waste will increase. The volume of needs to be reduced to a sustainable level.

This need have also provided a window of opportunity for cities to find solutions.

- ❖ Involving the community and private sector.
- ❖ Involving innovate technologies and disposal methods.
- ❖ Involving behavior changes and awareness rising.

Some private and community based organizations prove it that "trash can be cash". So, all it need to rethinking, organizing and planning about handling waste. It is obvious that the current approach for waste disposal that is focused on municipalities and uses high technology, to move more towards waste processing and waste recycling, and minimization. All these things involves public–private partnerships, community level awareness and participation, and using low energy / low technology resources.

Solid waste is any garbage, refuse, sludge, or other discarded material, including solid, liquid, semi-solid or contained gaseous material resulting from industrial, commercial mining, or agriculture operations or from community activities. (Islam, 2001) Each month, the plant produces 3 tons of bio-fertilizer, which sells for about \$0.04 per kilogram (Hai, 2002).

The revenue is enough to make the operation self-sustaining, covering production costs and providing well-paying jobs to employees. Wastes of slums can also be reduced.

The key activities and role for managing solid wastes of Dhaka city are performed by several groups of people. The four main types of actors in this process are:

- ❖ The Municipal Government(DCC).
- ❖ The Formal Private (Commercial) sector, in their role as potential solid waste function contractors like, Waste Concern, Bangladesh.

Almost 15 percent (i.e., more than 467.65 tons) inorganic fraction of the waste is recycled in Dhaka City (Enayetullah, 2002)

The overall objectives is to assess the condition of 10 slums of Dhaka city are

- ❖ To assess the selected slums for basic services- water supply, sanitation practice and waste disposal system.
- ❖ To compare the assessed condition with the same from literature data.
- ❖ To analyze the conditions of the slums statistically using T-test, F-test, Z-test and nonlinear regression analysis
- ❖ To find a way of reducing the environmental pollution by comparing the collected data

Essential goal of the study is to investigate the water supply, sanitation facility and waste disposal system of Dhaka City Corporation slums. It is an effort to understand these basic facilities and the overall environmental condition in different slums of Dhaka city in these days. This information can also play an important role to carry out of development program activities and improving the living condition of slums in future. A case study methodology is conducted to examine the general environmental scenario of 10 slums of Dhaka, port city of Bangladesh between 2016 and 2017. The slums under the study were chosen randomly from different study reports.

## 2. METHODOLOGY

A case study methodology is conducted to examine the general environmental scenario of 10 slums of Dhaka city of Bangladesh between 2016 and 2017. The slums under the study were chosen randomly from different study reports.

### 2.1. Data Collection System

The following flow-chart summarizes the research methodology that was followed for this thesis:

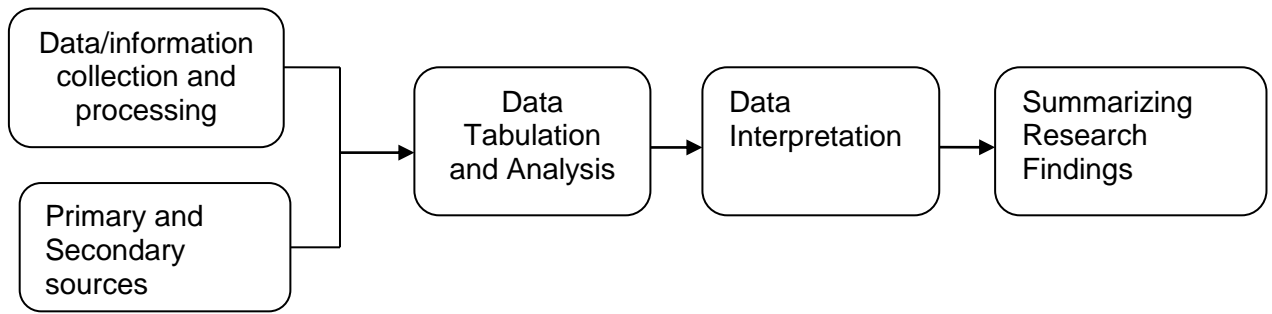


Figure 1: Stages followed in research methodology.

## 2.2 Scenario of Slums in Dhaka City

Total 10 numbers of slums are studied and the detailed scenario of the slums of Dhaka city parameters can be considered as follows:

### 3.1 Name Of The Studied Slums

- 1) Hazaribagh
- 2) kawnia Colony
- 3) Coloni Bosti
- 4) Tejgaon Bosti
- 5) Rishipara
- 6) Diyabari
- 7) Komlapur Bosti
- 8) Bou Bazar
- 9) Balurmat Colony
- 10) Kalunogor Bosti

### 3.2. Condition of Water Supply Facility

The classification of water sources in the slums of Dhaka city is shown below in figure 2

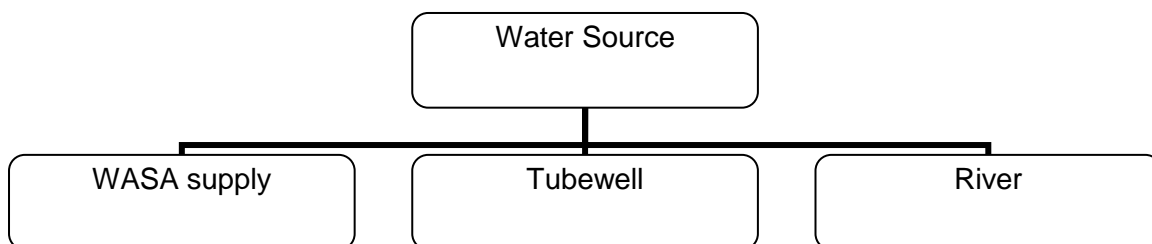


Figure 2: Classification of water source

### 3.3 Condition of Sanitation Practice

For the detailed and corresponding condition of slum sanitation practice, the pattern of sanitation as Single, Communal, Hanging and Open sanitation practice in slum areas is shown in Figure 3

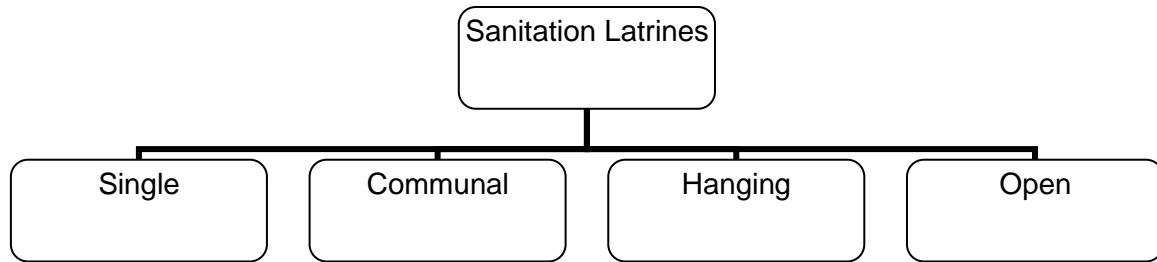


Figure 3: Pattern of sanitation facility

### 3.4 Condition of Waste Management System

Collected data of available waste disposal patterns categorized according to as Dustbin, Open space, Ditch and Community is shown in Figure 4

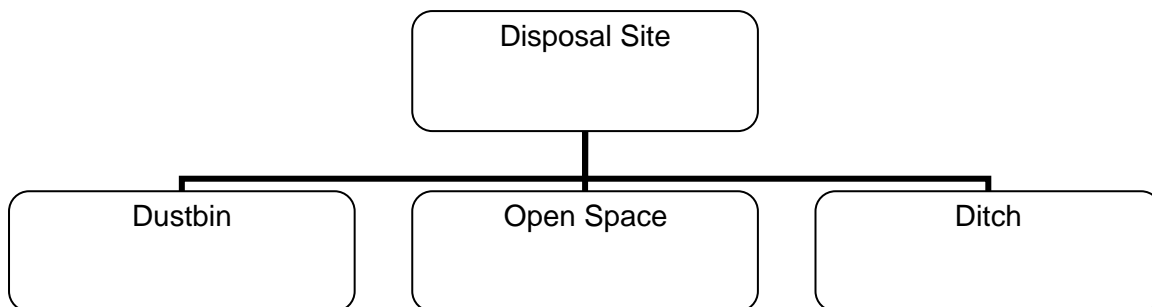


Figure 1 : Waste disposal pattern

### 3.5 Housing Condition

The quality of housing is one of the most basic indicators characterizing slum settlements. The majority of slum houses (56%) in the six cities were of very poor quality (weak and temporary structures or kutcha units), while another 42.4 percent were semi-pucca type (Star, June 2009). A very small proportion (1.1%) was dilapidated older buildings, while only 0.5 percent was good quality homes.

### 3.6 Food Consumption Pattern & Health Condition

Consumption pattern of slum dwellers depict that rice, potato, vegetable and edible oil are consumed on daily basis. Food composition sometimes is only rice with potato or peas or fish which are cheap to them. Protein energy intake is widely low in urban slums. Though, a large number of households can manage fish in weekly basis, but the quality of fish is relatively low. Inadequate access to safe water and sanitation leads millions of our people to various health problems. Water and vector born diseases like diarrhoea, dysentery, typhoid, worm infestation and polio, malaria, hepatitis A and E are too common in the slums. Many people are reported sick due to different types of water-borne diseases. 67% of affected people have been reported as suffering from diarrhoea (Solid & Management, n.d.). It is said that nutritious food prevents chronic disease as it helps children to recover disease quickly like diarrhoea. But majority of households cannot afford healthy food items like protein food, not even in weekly basis.

## 4. RESULTS AND DISCUSSIONS

### 4.1. T-Test (Interpretation of Correlation Coefficients)

T-test has been conducted between population with available water source, sanitation and waste management scenario respectively to understand the sufficiency compared to it. Comparing population with available water source: Here for ten slums we represent the water source by X and population by Y and the sum of X, Y, X<sup>2</sup>, Y<sup>2</sup>, XY is 69, 56200, 735, 443740000 and 378800 respectively.

$$\text{we know, } r = \frac{XY - \frac{\sum X \sum Y}{N}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{N}) * (\sum Y^2 - \frac{(\sum Y)^2}{N})}} = 0.049 \dots (1) \quad \text{Now, } t = \frac{r\sqrt{(n-2)}}{\sqrt{(1-r^2)}} = 0.138 \dots (2)$$

From two tailed T-table analysis if the degree of freedom is (10-2) = 8, t must be at least 2.306 to reach p<.05. But calculated t is 0.138, so there is no statistical relation between Population and Available Water Source. But if the no. of water source increases, significant relationship can be established between these two criteria. In other words, no. of water source is insufficient compared to the population in these slums. Comparing population with available sanitation facility: Here for ten slums we represent the sanitation system by X and population by Y and the sum of X, Y, X<sup>2</sup>, Y<sup>2</sup>, XY is 633, 56200, 61079, 444000000 and 5023600 respectively.

$$\text{we know, } r = \frac{XY - \frac{\sum X \sum Y}{N}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{N}) * (\sum Y^2 - \frac{(\sum Y)^2}{N})}} = 0.893 \dots (3) \quad \text{Now, } t = \frac{r\sqrt{(n-2)}}{\sqrt{(1-r^2)}} = 5.61 \dots (4)$$

From two tailed T-table analysis if the degree of freedom is (10-2) = 8, t must be at least 2.306 to reach p<.05. But calculated t is 5.61, so there is statistical relation between Population and Available Sanitation Facility. In other words, available sanitation facility is sufficient compared to the population in these slums. Comparing population with available waste management facility: Here for ten slums we represent the waste management by X and population by Y and the sum of X, Y, X<sup>2</sup>, Y<sup>2</sup> and XY is 13, 56200, 29, 443740000 and 105000 respectively

$$\text{we know, } r = \frac{XY - \frac{\sum X \sum Y}{N}}{\sqrt{(\sum X^2 - \frac{(\sum X)^2}{N}) * (\sum Y^2 - \frac{(\sum Y)^2}{N})}} = 0.812 \dots (5) \quad \text{Now, } t = \frac{r\sqrt{(n-2)}}{\sqrt{(1-r^2)}} = 3.93 \dots (6)$$

From two tailed T-table analysis if the degree of freedom is (10-2) = 8, t must be at least 2.306 to reach p<.05. But calculated t is 3.93, so there is a statistical relation between Population and Available Waste Management Facility. In other words, Available Waste Management facility is sufficient compared to the population in these slums.

### 4.2. F-Test to Understand the Relationship among the Studied Services Provided in the Slum

Here for ten slums we represent the water supply X1, sanitation facilities X2 and waste management X3 and the sum of X1, X2, X3, X12, X22, X32 is 69, 633, 13, 735, 61079, 29 and the sum of n is 30  
Grand Total (GT) =69+633+13=715

$$\text{Correction factor (CF)} = \frac{GT^2}{n} = \frac{715^2}{30} = 17040.83 \dots (7)$$

$$\begin{aligned} \text{Total Sum of Squares, } SS_T &= \sum (X_1^2 + X_2^2 + X_3^2) - CF \\ &= \left( \sum X_1^2 + \sum X_2^2 + \sum X_3^2 \right) - CF \dots (8) \\ &= 735 + 61079 + 29 - 17040.83 = 44802.17 \end{aligned}$$

Here,  $n_1 = 10, n_2 = 10, n_3 = 10,$  and  $K = 3$

$$\begin{aligned} \text{Sum of Squares between samples } SS_b &= \left[ \frac{(\sum X_1)^2}{n_1} + \frac{(\sum X_2)^2}{n_2} + \frac{(\sum X_3)^2}{n_3} \right] - CF \dots (9) \\ &= 40561.9 - 17040.83 = 23521.07 \end{aligned}$$

$$\text{Sum of Squares within Samples } SS_w = SS_T - SS_b = 21281.1 \dots (10)$$

Total Degree of Freedom =  $n-1=30-1=29$

Degree of Freedom between Samples =  $K - 1 = 3 - 1 = 2$

Degree of Freedom within Samples =  $n - K = 30 - 3 = 27$

$$\text{Mean of Sum of Squares between Samples } MSS_b = \frac{SS_b}{k-1} = 11760.535 \dots (11)$$

$$\text{Mean of Sum of Squares within Samples } MSS_w = \frac{SS_w}{n-k} = 7882.263 \dots (12)$$

$$F = \frac{MSS_b}{MSS_w} = 1.49 \dots (13)$$

From T-table ( $\alpha = .05$ ) for degree of freedom  $df_1=2$  &  $df_2=27$ , F ratio must be 3.35. But the calculated F value is less than that. So studied services in slums are not equally available. This means the facilities provided in these slums are not sufficient enough in each other's comparison. To lead a better life these services are yet to be improved. These facilities are related to each other to such an extent that improving one is not going to recover their situation. These facilities need improvement equally and at the same time too otherwise all the efforts will be in vain.

#### 4.3 Z-Test (Test Significance of Difference Between Two Sample Proportions)

Then,

$$Z = \frac{P_1 - P_2}{\sqrt{[P(1-P) * \left\{ \frac{1}{n_1} + \frac{1}{n_2} \right\}]}} \dots (14) \text{ Here, } P = \frac{n_1 P_1 + n_2 P_2}{n_1 + n_2} \dots (15)$$

*Hypothesis:  $\pi_1 = \pi_2$ ; no difference exists ;*

*$\pi_1 \neq \pi_2$ ; difference exists between samples.*

Water Supply Scenario of Studied Slums with Respect to Balurmat colony: For example, In Rishipara slum, Population, N<sub>1</sub> = 6000 and No. of water source, X<sub>1</sub> = 8 In Kawnia Colony slum, Population, N<sub>2</sub>= 3200 and No. of water source, X<sub>2</sub>= 4

$$\text{Here, } P_1 = \frac{X_1}{N_1} = \frac{8}{6000} = .0013 \text{ and } P_2 = \frac{X_2}{N_2} = \frac{4}{3200} = .00125; \text{ Here, } P = \frac{N_1 P_1 + N_2 P_2}{N_1 + N_2} = .00128$$

$$Z = \frac{P_1 - P_2}{\sqrt{[P(1 - P) * \left\{ \frac{1}{n_1} + \frac{1}{n_2} \right\}]}} = .0638$$

Table-1 : Water Supply Scenario of Studied Slums with Respect to Balurmat Colony.

Name of Slum	Population	Water Source	Ratio ,P=X/N	Total Ratio	Z	Error 5%	Decision
Rishipara	6000	8	0.0013	0.00128	0.0638	1.96	Huge Difference Between Two Slums
Kawnia Colony	3200	4	0.00125				

## 5.CONCLUSION

The Aim Of This Thesis Is To Determine The Overall Condition Of The Slums In Dhaka City Including Water Supply, Solid Waste Management, Sanitation System Etc. The Study Was Conducted By The Direct Interview Of Slum Dwellers And The Observation Of The Conditions Of Slums. The Study Shows That The Facilities Available In The Slums Are Not Sufficient For The Huge Number Of Slum Dwellers. Development Projects Should Be Implemented. Increasing Public Awareness Is Also Important. We Have To Include Some Recommendations That Can Be Applied For The Future Development Of The Slum. Out Of The Studied Slums, Condition Of Komlapur Bosti, Tejgaon Bosti, Bou Bazar And Kalunogor Are The Worst. So Far From Studied Survey, We Can See That The Value Of F Which Indicates The Relationship Among The Studied Services Provided In The Slums Is 1.49 Which Is Far Less Than The Standard Value That We Get From The F-Table. Also From The Z-Test We See That There Is Huge Difference Between Two Slums. So We Should Clearly Mention That Our Studied Slums Are Not Provided Sufficient Facilities. We Should Imply Safer And Healthier Water Source For The Domestic Uses Of The Slum Dwellers. Scattered Waste Is The Main Reason For The Sickness Of The Slum Dwellers, So We Should Stablish At Least 2-3 Nos Municipal Communal Bin In Every Slums. From Our Observation, Diyabari And Hazaribagh Slums Are Comparatively Good Condition Among The Ten Surveyed Slums. The Surrounding Of These Slums Is Quite Clean And Dwellers Are Provided Better Sanitation Facilities And Good Water Supplies From Wasa Or Shallow Tube Wells. Waste Management System Is Quite Good And Uniform In These Slums. Though People Are Not Fully Happy About Their Condition But The Condition Is Far Better Than Previous Slums.

## **REFERENCES**

- Enayetullah, S. (2002). Decentralized.
- Hai, F. (2002). solid waste Management in Developing Countries.
- Islam, D. (2001). Solid waste Management in Dhaka City. D.U. Journal Of Marketing, P-151-161.
- Islam, K. H. (2001). Solid Waste Management . D.U. Journal Of Marketing.
- Star, T. D. (June 2009). Report About the Urban Slums of Bangladesh. Chowdhury, T. A. (2006). Waste Management in Dhaka City-a Theoretical Marketing Model. Waste Management, III(2), 101–111.
- Solid, R., & Management, W. (n.d.). A proposal on - Copy.
- Town, C. (2009). Waste Data Base of.