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CRISIS OF ELECTRICITY, GAS AND WATER IN DHAKA CITY: A LOGISTIC REGRESSION MODEL APPROACH

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Abstract

Like chronic diseases, the power, gas and water crisis has gripped the city Dhaka and there seems to be no end to it. With every passing day the situation is worsening instead of being eased. The supply of power, gas and water are co-related. In fact, it is difficult to resolve one problem separately because water supply is disrupted due to power shortage and power crisis is caused by gas shortage. In this city of 15 million people, most people are hit hard by gas, power and water crises. At present, the gas supply is irregular in vast areas of the city. Frequent load- shedding is a regular phenomenon in the capital. The government is speaking of various projects to resolve the crisis, but implementation of those will need a few years while the crisis is already acute and requires immediate solution. So, the government should work out some plans for immediate implementation, for resolving the nagging gas, power and water crisis. The aim of this paper is to explore the causes and consequences of energy crisis in Dhaka city and to suggest some remedial measures to provide access to the city dwellers from the crisis of electricity, gas and water and help to ensure improved, quality of life. Three Logistic Regression Models (one for electricity, one for gas and one for water) were fitted to the collected data and identify the determinants of the basic needs so that strategic directions can be derived.

Keywords: Logistic regression, covariates, coefficients, p-value, odds ratio

Introduction

The denizens of the Dhaka city have to suffer an unprecedented scarcity of gas, electricity and water. In some areas, load-shedding ranges from eight to ten hours a day and there are localities running virtually without water. The same is true about the supply of gas falling drastically in many places. The picture is dismal and likely to worsen further in future. Usually such problems wouldn't arise all at the same time, but this time the services appear to be crumbling simultaneously. The suffering of patients also knows no bound. Furthermore, power-cuts have had a crippling effect on the working of WASA pumps which, in turn, aggravated the already precarious water supply. People have also complained of poor quality water, obviously is a health hazard. As for supply of gas, this has been erratic for quite a few years, but this year it has turned into critical situation. There is reportedly a deficit of around 2000-megawatt electricity in the country as 19 power

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generation units are not functioning. Some of the power generation plants have been hit by shortage of gas as fuel. So crisis in one sector is affecting crisis in another sector (The Daily Star, 2006). The gas crisis in Dhaka city is the talk of the country nowadays. People are going through a tough time. Daily affairs have come to a standstill. It is seen in the various electronic media that housewives are struggling to cope with their chores and cooking at late midnight to get satisfactory pressure of gas. During the time of need in the morning the pressure remains too low to cook. Houses having children and sick elders are no doubt in a chaotic condition. Question comes, why this is happening? The very basic theory of economics can be applied here the demand of gas is high, but the supply is very inadequate. The more urbanization and industrialization we are heading for, the more we are in need of gas. Gas is used for cooking, producing electricity, for running mills and factories. In coming days, it will be a Herculean task for the government to provide uninterrupted supply of gas. But, this natural resource is being spoiled due to our carelessness and callousness. Sometimes, some of us keep the fire of oven on to save a match stick! It is also a common picture of some city dwellers to put clothes over the burning oven to make them dry. We do not try to understand that it is our national loss (Rahim, 2010).

As the load-shedding continued across the country during the current humid summer, most of the consumers now do not believe that the present government has added more than 3,000 megawatt (mw) of electricity over the last three years, as being claimed by it. More than 20 oil-fired rental and quick rental power plants, which have been set up so far, cannot be run 24 for hours due to high price of imported oil. Different industries and service providers, mainly the small and medium enterprises (SMEs), have been experiencing around 30 to 40% production loss following erratic power supply in the city. Besides, the businesses are paying at least 12 per cent extra as fuel costs for operating generators. Most of the small and medium enterprises (SMEs) are suffering largely due to the power shortage. The SMEs need eight hours uninterrupted power supply as frequent power failure is forcing them to sit idle. The backup power systems like the instant power supply (IPS) are also sometimes failing to work as they do not get enough electricity for recharge. According to a report, resumption of fertilizer production in two gas-guzzling factories has squeezed gas supplies to power plants resulting in lower electricity generation. Power sector officials came up with the same old excuse that consumption of electricity had increased manifold and that, due to poor gas supply and technical problems, the required megawatt of power could not be generated. Increased use of cooling devices at houses, offices and other establishments is also a reason behind the power shortfall. Every year demand is increasing at the rate of 10 percent and generation capacity of older power plants decreasing significantly (The Financial Express, 2012).

On the water front, Dhaka WASA is now capable of supplying around 1.50 billion liters of water per day in the capital and Narayanganj town against an average summer time

demand of over 2.20 billion liters. Normally, the Dhaka WASA can supply around 1.60 to 1.65 billion liters of water to the residents of Dhaka city and Narayanganj town from its two water-treatment plants and 410 deep tube wells. WASA is now facing severe crisis in lifting underground water as there is no back-up support of its deep tube-wells to keep them operational during load shedding. Moreover, a large number of deep tube-wells are now out of order and the condition of the water treatment plant at Pagla is not satisfactory. Around 88% of water is lifted through deep tube-wells from the underground while rest is supplied from two treatment plants. Steps are under way to lift more underground water to meet additional demand despite power crisis. Water crisis has taken a serious turn in recent times. Everyday hundreds of patients, mainly children, are being admitted to the ICDDR-B in the city with water-borne diseases.

Materials and Methods

For the following study primary data were collected from 250 households of Dhaka city during January to February 2012. Respondents were selected using simple random sampling from different areas of Dhaka city in such a way so that people of all economic class and all professions are included in the sample. The sample size was determined using the formula:

$$n = \frac{z^2 pq}{d^2} = 245.86 \approx 246$$

where,

n = desired sample size

z = normal standard variate with 95% confidence level. The value of z is 1.96

p = the estimated prevalence (assume 80% or 0.80)

q = 1-p = 1-0.8 = 0.20

d = degree of accuracy desired, usually set at 5% (0.05)

Face to face personal interview technique was used to collect data from the respondents, using structured questionnaire. The purpose and nature of the study was explained to each participant and after getting the verbal consent they were interviewed in the study. Statistical software SPSS was used to enter the data into computer and analyze the data. Three Logistic Regression Models (one for electricity, one for gas and one for water) were fitted to the collected data.

Logistic regression **is** a type of regression used when the dependent variable is binary or ordinal. Multiple linear regression may be used to investigate the relationship between a continuous (interval scale) dependent variable. However, socio-economic variables are very often categorical, rather than interval scale. For example, the dependent variable

might be 'unemployed' or 'not', and we could be interested in how this variable is related to sex, age, ethnic group, etc. In this case we could not carry out a multiple linear regression as many of the assumptions of this technique will not be met, instead ken formed a logistic regression. In many cases research focuses on models where the dependent variable is categorical.

Results and Discussion

Fitting logistic regression model for gas

In the logistic regression model for gas, the dependent variable (Y) is scarcity of gas and the independent variables are: use gas except cooking (X_1), misuse of gas (X_2), illegal connection (X_3), gas field (X_4), technical support (X_5), others (X_6). The logistic regression model used here is as follows: $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6$

Where β_i's denotes the coefficients of the explanatory variables, (i=1, 2, 3, 4, 5, 6).

Table 1. Fitting of logistic regression model for gas

Dependent Ariable	Covariates	coefficients	P-values	Odds ratio
Scarcity of gas	constant	9.271	0.001	10629.02
	Use gas except cooking	0.010	0.988	1.010
	Misuse of gas	-.380	0.550	0.684
	Illegal connection	-2.978	0.007	0.051
	Inadequate no. of gas field	-1.344	0.032	0.261
	Lack of technical support	-2.712	0.020	0.066
	All	-2.218	0.001	0.109

From Table 1 we observe that odds ratio for use gas except cooking is 1.01 implying that an individual who uses gas except cooking is 1.01 times more likely to face scarcity of gas as compared to an individual who does not use gas except cooking considering all other factors at fixed levels. Similarly the odds ratio for misuse of gas is .684 which means that an individual who misuse gas is two-third times less likely to face scarcity of gas as compared to an individual who does not misuse the gas considering all other factors as constant. The odds ratio for illegal connection of gas line is 0.051, which means that an individual who have illegal connection of gas line is highly unlikely to face scarcity of gas as compared to an individual who does not have illegal connection of gas line considering all other factors as constant.

Again, the odds ratio for inadequate number of gas fields is 0.261, which means that the reason, inadequate number of gas field is 26% responsible for scarcity of gas as compared to the cause, adequate number of gas field considering all other factors as constant. The odds ratio for lack of technical support is 0.066, which means that the

reason, lack of technical support is 6% responsible for scarcity of gas as compared to the cause, availability of technical support considering all other factors as constant. Also, the odds ratio for all the mentioned factors together is 0.109, which means that all the mentioned factors together is 1% responsible for scarcity of gas as compared to the other important factors considering all other unimportant factors as constant.

Fitting logistic regression model for electricity

In the logistic regression model for electricity, the dependent variable(Y)is suffering from load shedding in city life and the explanatory variables are over population (X_1), misuse (X_2), illegal connection (X_3), less production (X_4), number of gas field (X_5) and others (X_6). The logistic regression model used here is as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6$$

Where β_i's denote the respective coefficients of the explanatory variables respectively, (i=1, 2, 3, 4, 5, 6).

Table 2. Fitting of logistic regression model for electricity

Dependent variable	Covariates	coefficients	P-values	Odds ratio
Suffer from load-shedding	Constant	4.380	0.022	79.860
	Over population	0.333	0.619	1.395
	Misuse	-1.505	0.060	0.222
	Illegal connection	-.054	0.940	0.947
	Less production	-1.049	0.122	0.350
	Inadequate no. of gas field	-.082	0.903	0.921
	Others	0.138	0.905	1.148

From Table 2 we observe that the odds ratio for over population is 1.395, which indicates that the scarcity of electricity is 39.5% higher in the Dhaka city due to the overpopulation when all the factors are at fixed levels. Similarly, the odds ratio for misuse of electricity is 0.222 implying that an individual who misuse electricity is one-fourth times likely to suffer from load-shedding as compared to an individual who does not misuse electricity considering all other factors as constants. The odds ratio for illegal connection of electricity is 0.974 which means that an individual who have illegal connection is highly likely (97%) to suffer from load-shedding as compared to an individual who does not have illegal connection of electricity considering all other factors as constant.

Similarly, the odds ratio for less production of electricity is 0.350, which means that the reason, less production of electricity is about one-third times responsible for load-shedding as compared to the reason, more production of electricity considering all other factors as constant. Again the odds ratio for inadequate number of power plant is 0.921 which means that the reason, inadequate number of power plant is highly responsible for load-shedding as compared to the cause, adequate number of power plant considering all

other factors as constant. The odds ratio for other factors together is 1.148 indicating that they together are 1.148 times as more likely are responsible for load-shedding as compared to another factor keeping all the mentioned factors at fixed levels.

Fitting logistic regression model for water

In the logistic regression model for water, the dependent variable (Y) is the required quantity of water and the explanatory variables are seasons in which water crisis arises (X_1), extraction of ground water (X_2), over population (X_3), capacity deficiency (X_4) and timely payment of water bill (X_5).

The logistic regression model used here is as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5$$

Where, β_i's denote the respective coefficients of the explanatory variables, (i = 1, 2, 3, 4, 5).

Table 3. Fitting of logistic regression model for water.

Dependent variable	Covariates	coefficients	P-values	Odds ratio
Get required quantity of water	constant	1.718	0.132	5.574
	Season in water crisis arises	-1.021	0.336	0.360
	Extraction of ground water	-.162	0.634	0.851
	Over population	0.126	0.711	1.134
	Capacity deficiency	0.512	0.132	1.669
	Timely payment of water bill	-.333	0.675	0.717

From Table 3 we observe that odds ratio for season in which water crisis arises is .36 indicating that a season in which water crisis arises is about one-third times likely to get less quantity of water compared to another season, in which water crisis doesn't arise considering all other factors at a fixed level. It is clear from the table that odds ratio for excessive extraction of ground water is .851 which indicates that excessive extraction of ground water is highly (85%) responsible to get required quantity of water, considering all other factors at a fixed level. The odds ratio for over population is 1.134 which means that huge population is 13.4% more likely responsible for scarcity of water as compared to the less population is responsible for scarcity of water, keeping the other factors as constants. From the table we observe that odds ratio for capacity deficiency is .36 indicating that the reason, capacity deficiency is one-third times less responsible for scarcity of water as compared to capacity sufficiency considering all other factors at a fixed level.

Conclusions

Our entire way of life and all of our economic projections demand more and more energy. Howbeit, the world is now facing the most serious challenge in energy supply which could be a more devastating crisis than world wars. Global energy depletion has

already begun, although few countries have realized it. The peak demand of energy affects the future of the entire global economy. Presently energy producing resources like fossil fuel, gas, coal, and uranium have reached their peak. It is predicted that these non-renewable energy resources are going to decline in every place of the earth (Rahman, 2012). Energy is one of the most important ingredients required to alleviate poverty and to promote human and socio-economic development. To overcome present conditions we need energy returned on energy invested, ban profligate users, increase public awareness, implement policies, generate individual or household level options, community or private sector initiatives along with investments, zero interest bank loans for renewable energy initiatives and a law and order situation to be enforced. Furthermore, we need a feasibility study for those technologies aimed at adopting suitable technologies to produce electricity from renewable resources. Close your eyes and think for a second, what will be the situation without or with only insufficient electricity supply for Dhaka? It will become a completely dead city (Rahman, 2012).

For decades now, people living in Bangladesh have taken gas for granted. Bengalis are very wasteful in nature and all these years they have been leaving their gas cookers running even when not in use. They never thought that this gas may run out or run low sometime in future and people would face a severe crisis. In other countries like Kenya, people have to stand in long lines in order to purchase gas in cylinders and then use it sparingly to make it last. It is high time that people in Bangladesh realized the value of our limited resources and stop taking them for granted (Rahim, 2010).

The country would not have faced any gas crisis now if the government paid a little attention to capacity building and modernizing the companies under Petrobangla instead of becoming over-dependent on foreign oil companies to produce gas, experts say (Rahim, 2010). We need to go for LPG, as the people of our country misuse gas. Besides, the price of LPG is less than pipeline. The govt. can activate the prepaid system. Again, the govt. can import *Liquefied natural gas* (LNG) if we do not have any prospect. By increasing awareness among people for using biogas, finding adequate number of gas fields by using new technologies, introducing prepaid meter for household gas distributions govt. can reduce the scarcity of gas.

From renewable energy sources, Bangladesh government has set a target to meet 5% by the year 2015 and 10% by 2020 of total power demand. However, the government has already taken some effective initiatives for enhancing efficiency of electricity use through energy saving bulbs distribution among urban communities. Some government offices, institutions and also other places are now installing solar panels for the purpose of alternative power generation (Rahman, 2012). Government should give special concern on distributing electricity in a balanced way and arranging seminars and conference for increasing consciousness among people for using solar energy and energy saving bulbs to save electricity.

However, there is neither enough wind for wind power nor enough river current for hydroelectric power nor any suitable peri-urban places to install nuclear power plants. Nuclear power plants might be suitable to generate a large amount of power and are free of carbon emissions but are considered risky due to the high frequency of earthquakes in the region. Surprisingly, Dhaka is situated in one of the highest solar radiation receiving zones in the world with almost 335 sunny days a year. Hence, to generate solar photovoltaic energy is the best option for Dhaka city to face the present energy crisis (Rahman, 2012). Compulsory installation of solar devices on the rooftops of the high-rise buildings is a good move.

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