DETECTING THE CAUSES OF WATER LOGGING PROBLEM IN DHAKA CITY BY APPLYING CONTINGENT VALUATION METHOD AND REMOTE SENSING TECHNIQUE

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ABSTRACT:

Although flood is a very common natural disaster in Bangladesh, recently Dhaka, the capital city of Bangladesh got flooded even in moderate rainfall. Accordingly, on January 2002 the sale and use of polythene bags were banned, by identifying it as one of the main causes for such flooding. Now the question arises, whether only polythene shopping bags are alone responsible for causing water logging problem. Accordingly, the objective of this study is to detect the reason(s) for the recent prolonged water logging problem in Dhaka City, even by small amount of rainfall. Both contingent valuation method and remote sensing technique were used for comparison of the results. The results of the study indicated that, not only polythene bags, but also unplanned land filling is also liable for creating water logging problem in Dhaka City. Finally, the study suggested that, the value of wetlands lost, which is directly related to the recent water logging problem, is more higher than what actually thought by the citizens of Dhaka City.

KEY WORDS: Water Logging, Wetland, Polythene Shopping Bags, Contingent Valuation Method, Remote Sensing

1. INTRODUCTION

Historically flood is a common natural disaster in Bangladesh. Being the capital of Bangladesh, Dhaka City is also no exception to this (see Figure 1 for the location of Dhaka City). But in the last decade Dhaka City got flooded even in moderate rainfall. The damages caused by the floods in 1988 and 1998 are shown by the Table 1. Long duration of water logging due to floods, which destroys infrastructure of the city and causes different diseases. As we can see from Table 2, duration of flood in 1998 was 65 days as compared to 30 days in 1988. Although the flood in 1988 was severe than that of 1998, the water in the former receded faster than in 1998. Now the question is why suddenly rain waters are not receding in usual pace in Dhaka City in the last decades? There might be several factors responsible for this problem, such as: unplanned filling of the wetland area of the city by city developers,

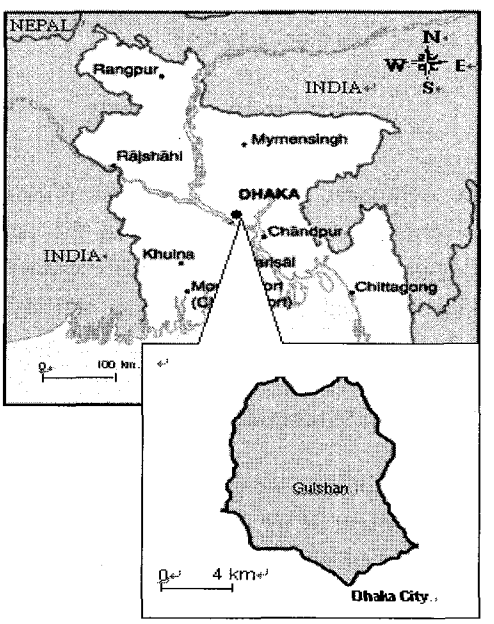


Figure 1. Location of Dhaka City

jamming of the city drainage system due to discarding

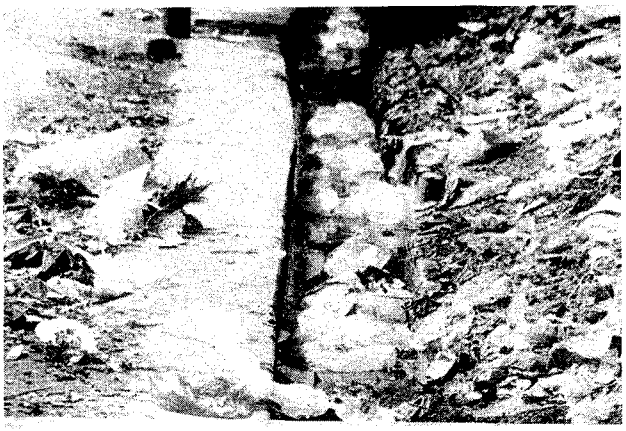


Figure 2. Polythene bags clogging the drains

of poly-bags, sedimentation in rivers and canals reducing their water storage capacity during rainy season etc. Among them the government bodies identified polythene shopping bags as one of the main causes for such flooding (ESDO, 2002) (see Figure 2). Accordingly, on January 2002 the sale and use of polythene bags were banned in Capital City Dhaka by the Bangladesh Government, followed by a nation wide ban went into effect from March 2002. Now the obvious question is: how this banning of polythene bags helped in reducing flood disaster or water logging problem in Dhaka City? In order to know the answer to this and related questions, this study aims to undertake a modest attempt to detect the causes of water logging problem in Dhaka City by using both remote sensing and economic valuation technique.

2. DATA AND METHODS

Both Contingent Valuation Method (CVM) and remote sensing were used for detecting the causes of water logging problem in Dhaka City. Research flow of the study followed is outlined below and shown in Figure 3:

2.1. Contingent Valuation Method (CVM)

Under contingent valuation method, this paper presents the result of the final study. Direct interview method with double bounded dichotomous choice (DC) and open-ended (OE) elicitation method have been used for estimating the willingness to pay (WTP) for solving the factors causing the water logging problem. Among the various factors causing the water logging problem in Dhaka City, we have short listed two: polyphone shopping bags and filling of wetlands, and asked the

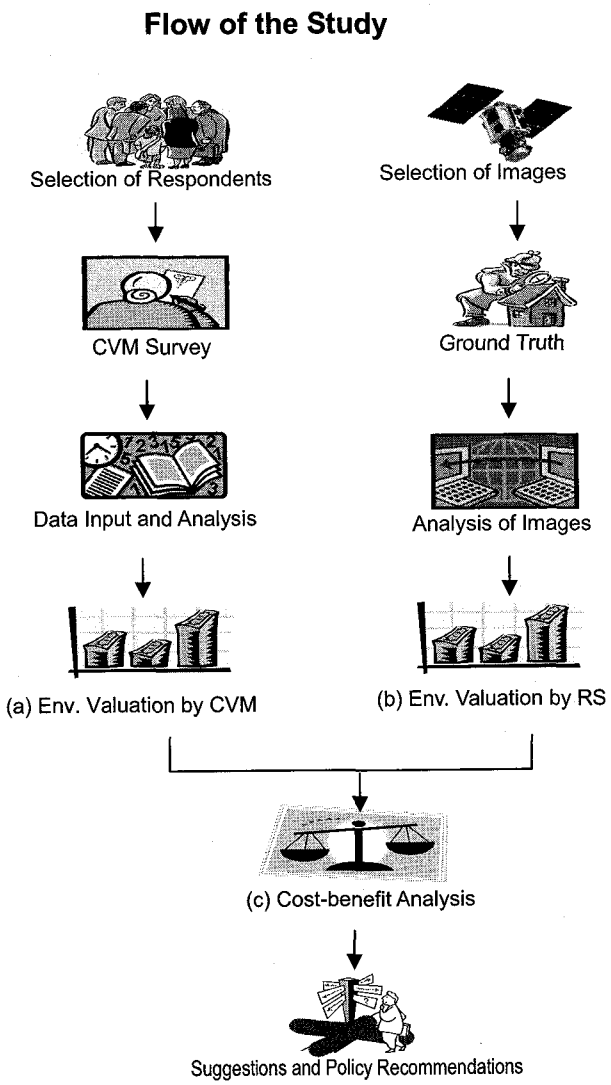


Figure 3. Flow chart of the study

citizens of Dhaka City, how much they are willing to pay for keeping the polythene shopping use banned and recovering the lost wetlands marked under Wetland Conservation Act 2000.

Table 1. Damages caused by floods in Dhaka

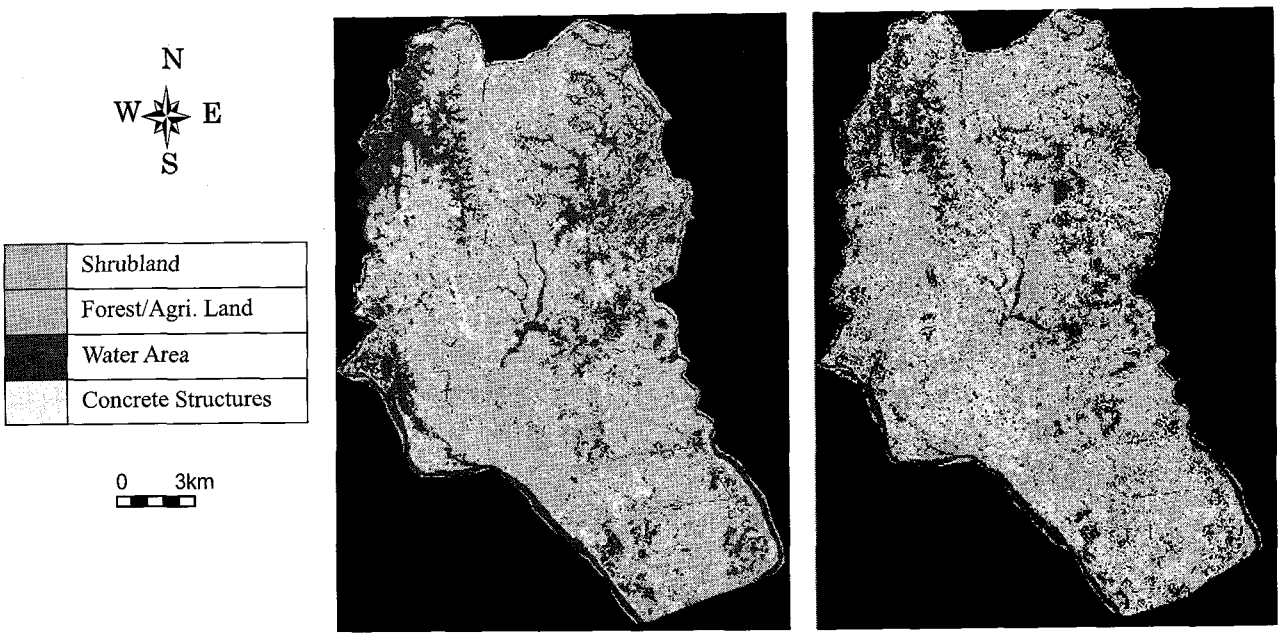
	1988	1998
Affected Population	4.55 Mil.	2.2 Mil.
Infrastructure: roads, water supply etc.	127 Mil. Taka	-
Housing Damage	2,311 Mil. Taka	4.4 Bil. Taka

Source: Reconstructed from Huq and Alam, 2002

Table 2. Characteristics of floods in Dhaka

	1988	1998
Area of Dhaka inundated	85%	56%
Duration of flood	30	65
Date of crossing danger level at rising stage	4th week of August	3rd week of July

Source: Same as above



a) 12 January 1989 b) 19 January 2003

Figure 4. Land cover changes in Dhaka City

2.2 Land Cover Mapping

Land cover mapping by satellite remote sensing images of LANDSAT-4 and 7 are conducted to determine the land cover changes in Dhaka City between the periods of 1989 to 2003. Then the area of wetland lost is converted into monetary figures.

3. FINDINGS

3.1 Valuation of Causes by CVM

The findings of the CVM study are summarized through Table 3.The respondents who had resisted paying in all of the two bids are considered to have zero WTP. Accordingly the mean willingness to pay (WTP) is estimated to be Tk. 650 for banning the production and use of polythene shopping bags (Taka is the name of the official currency of Bangladesh; 1 Taka = US$ 0.01538 as on Sept. 27, 2006) (see Table 3).

Whereas, the mean WTP is estimated to be Tk. 250 for recovering the wetlands lost. Next we have extrapolated the mean WTP of Tk.650 and Tk.250 to the entire 2,089,336 (BBS, 2001) private households of Dhaka City to estimate the benefits received from both the factors.

Table 3. Total estimated WTP

Description	Banning Polythene Shopping Bags	Recovering Wetlands
Sample size (complete)	1050	1050
Mean WTP (Tk./household)	650 [a]	250
Total Number of Households in Dhaka City	2,089,336 [b]	2,089,336 [b]
Estimated Total WTP (Million Taka)	1400	522

Note : [a] Rounded to nearest 10 Taka (Tk.).
Source: [b] BBS, 2001

Table 4. Land cover change in Dhaka City

Classification	Area in 1989 (%)	Area in 2003 (%)
Water Area	24	18
Forest/agricultural land	34	23
Shrub land	23	20
Concrete Structures	21	36

Accordingly, we found that, the residents of Dhaka City are willing to pay approximately Tk. 1.4 Billion and Tk. 522 Million for banning the use of polythene shopping bags and recovering wetlands, respectively. F Thus form these two figures in monetary terms we can compare the severity of causes for water logging as thought by the citizens of Dhaka City.

3.2 Valuation of Causes by Land Cover Mapping

In this section of the study, we have examined how much of the wetland area of the Dhaka City actually lost in recent years and its worth by applying remote sensing technique. In order to do this, we have examined the land cover changes by satellite images of LANDSAT-4 and 7. Images of 12 January 1989 and 19 January 2003 were used to estimate land cover changes. Table 4 and Figure 4 show such result by unsupervised classification. From the results of the classification verified with ground truth and GIS map of Dhaka City (Mappa, 2002), it has been revealed that in 1983, the Dhaka City had water area, forest or agricultural land, concrete structures and shrubland of 24%, 34%, 21% and 23%, respectively (see Figure 4a). On the other hand, in 2003 the water area is reduced to 18% as compared to that of 24 % in 1989. The area of Dhaka City is 118.62 square kilometers and 6 percent of it is 712 hectares (Rahman, 2004). Thus we can roughly conclude that around 712 ha of wetland or water bodies has been lost in the period between 1989 to 2003.

Next let us determine the value of this wetland area lost. Costanza et al. (1997) attempted to place a total value on the Earth's ecosystem and estimated the total area covered by 17 biomes classified by Bailey (Costanza et al., 1997). In valuing biome, the services provided are identified and valued accordingly. In this study, the value placed for wetlands in the category of swamps/floodplains is Tk.1.3 million (US$19,580) ha^{-1} yr^{-1}. Based on this we have calculated the present value of the wetlands lost in perpetuity by taking 3% discount rate. The formula for calculating present value of a sum in perpetuity is as follows:

$$PV = \frac{c}{r} \qquad (1)$$

Where, PV is the present value, C is the annual cash value and r is the discount rate. Accordingly, the value of 712 ha of wetland lost in perpetuity becomes approximately Tk.31 Billion.

Table 5. Comparison of the valuation findings

Description	Banning Polythene Shopping Bags (WTP)	Recovering Wetlands	
		WTP	Land Cover Mapping
Estimated Total WTP (Billion Taka)	1.4	0.522	31

3.3 A Comparison of the Valuation

Through the comparison of the three valuations made, we can conclude that people who are blaming polythene shopping bags for the water logging problem in Dhaka city are valuing this cause as Tk.1.4 Billion (See Table 5). Whereas, those who are blaming filling of wetlands are valuing this cause as Tk. 0.52 Billion. In addition to this, if we look into the land cover change of Dhaka City from the period of 1989 to 2003, then we can roughly say that the value of the wetlands lost during this period is much more larger, i.e., Tk. 31 Billion, approximately.

4. CONCLUSION

In this study, we have taken a modest attempt to find the causes for water logging problem in Dhaka City both form socio-economic and technical view-point. From the results of the study we have found that, citizens of the Dhaka City are blaming both polythene shopping bags and filling of wetlands for causing water logging problem in Dhaka City. However, the amount they are willing to pay for keeping the polythene bags are higher than that for the recovering of wetlands. One reason for this might be that, polythene bags jamming the drainage system are more clearly visible to them than the gradual land filling and encroachment of wetlands. Also the actual value of the wetland lost is much higher than what citizens are thinking presently.

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