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Analyzing the Proposals of FAP 8B Project of Dhaka and Present Context of Retention Pond Areas and Canals

Bivash Das[*]
Dr. Ishrat Islam[**]

Abstract

After the devastating flood of 1988, the government adopted a program under FAP-8B to protect Dhaka city from flooding. It included two-part coordinated action plan, namely FAP-8A & FAP-8B. The project "FAP-8B" covered 136.5 sq. km of western part of Dhaka and the primary objective was to provide a relatively flood free and secured living environment. Proposals of FAP-8B focused on construction of retention ponds with pumping facilities and rehabilitation of 21 major natural canals having a total length of 78.6 km. The FAP-8B project started in 1991 and completed by 1997. This paper studied the land use changes within the designated retention pond areas and canals in the FAP-8B area through interpretation of satellite images and data on physical features. The study used satellite images of the years 1989, 1999, 2004, 2007, RS (Revenue Survey) maps and land use maps of Detailed Area Plan (DAP). Findings of the study revealed that proposed 4.5% retention pond areas of FAP-8B has been encroached by various land use activities and at present only 1.79% retention pond areas are left. Encroachments of natural canals are also alarming. It is found that 34% area of 13 natural canals has been filled up by developers, private individuals and others. Between 1989 and 2007, area of wetland was reduced from 22.15% to 12.17% in the west Dhaka. The results suggest that without government intervention to save the remaining retention areas and canals, it would be difficult to uphold the flood control functions of FAP-8B project.

Introduction

Flood occurs almost every year threatening rural and urban inhabitants of Bangladesh. Dhaka has experienced major floods in 1954, 1955, 1970, 1974, 1980, 1987, 1988, 1998, 2004 and 2007 due to the over flow of surrounding rivers (Huq and Alam, 2003). During 1988 flood, about 77 percent areas of Dhaka City (total area 260 sq. km) were submerged to a depth ranging from 0.3 to 4.5 meter and affected about 60 percent of the city population. Encroachment of water storage areas by land filling is one of the major causes of rainfall flooding and drainage congestion in many locations of Dhaka City (Chowdhury et al., 1998). Several study carried out in 1988-89 to develop a comprehensive flood policy and program for Bangladesh, including Dhaka City. Based on the study results, Flood Action Plan (FAP) was formulated under the coordination of the World Bank in November 1989. In support of Government's flood action program, both the government of Japan and the Asian Development Bank (ADB) were agreed to provide assistance for Dhaka Town Protection component, FAP-8. It was a two part coordinated action plan namely FAP-8A & FAP-8B. The project "FAP-8B" covered 136.5 sq. km of western part of Dhaka. The

[*] Urban Planner, District Towns Infrastructure Development Project (DTIDP), Local Government Engineering Department (LGED), Agargaon, Dhaka. Email: pbdas99@yahoo.com

[**] Associate Professor, Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology (BUET), Dhaka. Email: ishrat_urp@yahoo.com

objective of the FAP-8B was to provide a relatively flood free and secured living environment within the framework of a long term flood protection program for Dhaka. FAP-8B had four parts namely: Part-A: Flood Protection; Part-B: Drainage; Part-C: Environmental Improvement; Part-D: Implementation Assistance. Part: A & B comprised of the proposals on drainage and retention ponds. FAP-8B proposed for three retention pond areas with pumping facilities. Location of these retention pond areas were Goranchatbari, Kallyanpur and Dholaikhal. It is worth mentioning here that during the implementation phase, the government could not acquire the required amount of land for retention pond. Table 1 shows the amount of proposed and acquired land for retention pond in the FAP-8B area. In Goranchatbari site, about 274 hectors land was designated as retention pond areas, whereas FAP-8B proposed for 304 hectares of areas. The scenario of Kallyanpur site is most frustrating, out of proposed 306 hectares, only 3.2 hectares of land was brought under retention pond site. The old Narinda pond was the third retention site, chosen for Dholaikhal Pumping Station comprising of 4.2 hectares of land.

Table 1: Proposed and acquired retention pond areas in the FAP-8B area of west Dhaka

Name of the pond area	Proposed area according to the map of FAP-8B (ha)	Acquired/ Govt. land (ha)
Goranchatbari	304.4	274.0
Kallyanpur	306.4	3.2
Dholaikhal	-	4.2
Total	610.8	281.4

Source: Authors using Field investigation & Secondary Data Analysis, 2009

Another major component of the plan was rehabilitation and upgrading of 21 major khals (canals) of total length of 78.6 km. Improvement through rehabilitation of internal drainage khals and construction of storm drainage were important activities under the plan. Construction of pump stations for west part of Dhaka were also prioritized (JICA, 1991).

During the disastrous flood of 1998, Western part of Dhaka showed successful mitigation measure than any other affected part of the city but failed to take its full strength protective measures. In 1998 flood, water entered into the protected part of the city through hydraulic leakage such as buried sewerage pipes, breached and incomplete floodwalls, un-gated culverts and inoperative regulators. At that time, the drainage network and retention pond of the city were found to be in poor conditions and capacities of the pumping stations were found inadequate (Faisal et al., 2003). But due to the inadequate internal drainage system and illegal invasion of natural drainage, performance of the Dholaikhal and Kallyanpur pumping stations are now found dissatisfactory.

The focus of this research was to study the proposals of FAP-8B projects and their implementation status. This research also investigated the nature and trend of encroachment of retention pond areas and canals proposed and designated in FAP-8B project since 1989. Based on the findings, an attempt has also been made to make some recommendations pertaining to wet land management.

Study Area

The western part (FAP-8B area) of Dhaka City is located approximately in between longitude 90°19' E to 90°25' E and latitude 23°40' N to 23°53' N. The area is surrounded by Progati Sarani on the east, Turag River on the west and north and Buriganga River on the south. Figure 1 shows the study area. Total area of the Dhaka western part is 136.5 sq. kilometers (13,650 hectares or 33,730 acres) consist of 73 wards. It covers almost all of the built-up areas of the city (residing 73.6 % population of DCC area) (BBS, 2001). It includes the restricted areas of KPI (Key Point Installations) like Zia International Airport, Dhaka Cantonment. Major land use in the study area is residential and it covers 51 % of the total land area. Lands used for residential purpose cover 14.7% as planned area and 36.3% as unplanned area. The road network covers about 9.2% area. Significant portion (about 11%) of lands are mixed use (DAP, 2008).

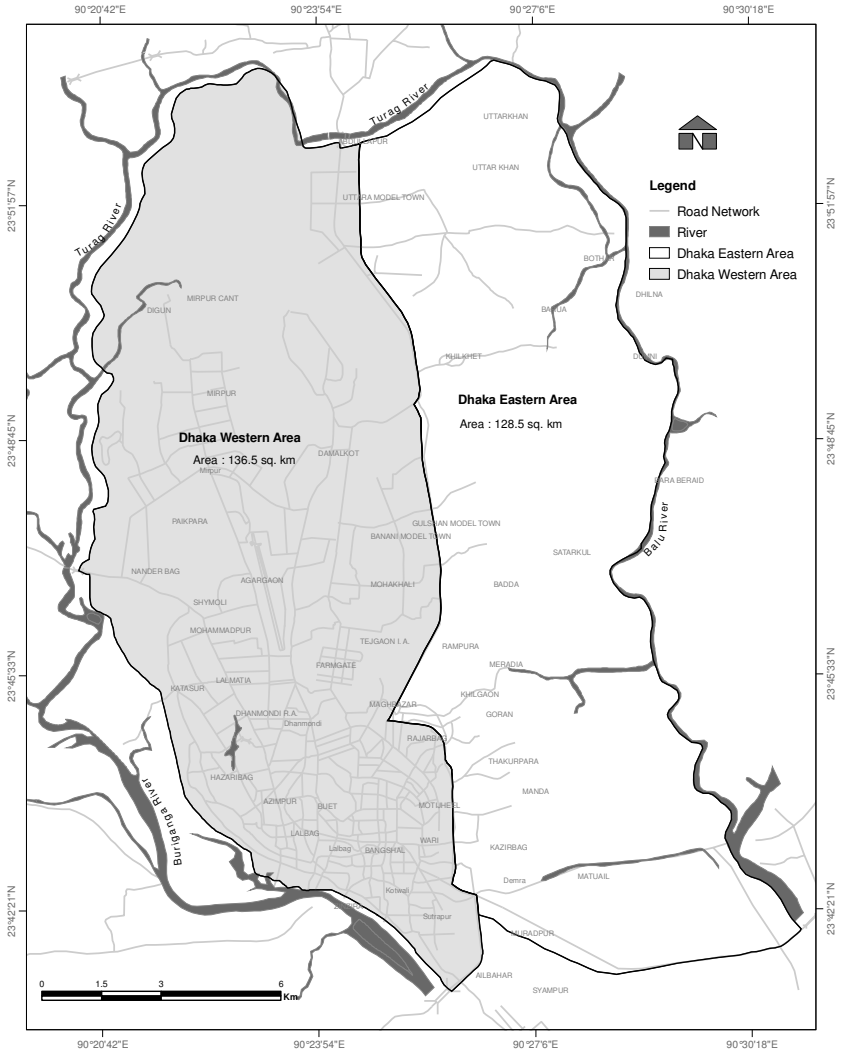


Fig. 1: Western part of Greater Dhaka

Dhaka City is comprised of several water retention areas and khals, which are drained to the surrounding rivers. The city's storm water is accumulated in the retention areas and discharged to the surrounding rivers through khals. All these khals and lakes had outlets to the surrounding rivers namely Buriganga, Turag, Balu Rivers and low lying areas. About 30 km Buriganga River and 23 km Turag River are adjacent to the western part. Average depth and width of Buriganga River is 8-12 feet and 200 feet whereas Turag River has 8 feet and 120 feet respectively (BIWTA, 2005).

Historically Dhaka possessed an efficient natural drainage system comprised of networks of natural canals and low-lying land surrounding the highlands of Dhaka. But unfortunately, the development trend of Dhaka continued to ignore its topography and physiographic context. The research of Islam (2009) showed the alarming loss of wetlands of Dhaka Metro area since 1989. In the study area, at present only 86.59 hectors of ditch, 413.18 hectares of marshy land and 66.71 hectares of pond are available (DAP, 2008).

Research Framework

The issues of land use changes due to urbanization have been already discussed in a number of studies. Remote sensing, in conjunction with geographic information systems (GIS), has been widely applied and been recognized as an effective tool in detecting land use and land cover change (Weng, 2001). Principal components of the methodology adopted for this study are as follows:

I. Satellite Image interpretation is the useful method for analyzing the trend of land use change. The Remote Sensing Images (TM, ETM and IKONOS) for this study were acquired of 28 Feb., 1989; 24 Nov., 1999; 8 Aug., 2004 and 10 Oct., 2007. Also, field investigation conducted for the determination of the existing scenario of the land use.

II. Retention pond areas are identified from land use proposal of the FAP-8B, 1991. Natural drainage or Khal areas are identified from Revenue Survey (RS) map. Land use changes of the retention ponds and khal areas have been identified from existing physical feature map and land use map of Dhaka Detailed Area Plan, 2008. Spatial data analysis conducted with GIS software like PC Arc Info 3.5.1, Arc View 3.2a and Arc GIS 9.0.

Land Use Change in the West Dhaka (FAP-8B area) Since 1992

Urban area expansion has been largely driven by infrastructure development, population growth and economic development. As a result, infilling of low-lying areas and clearing of vegetation are resulted in a wide range of environmental impacts, including habitat quality.

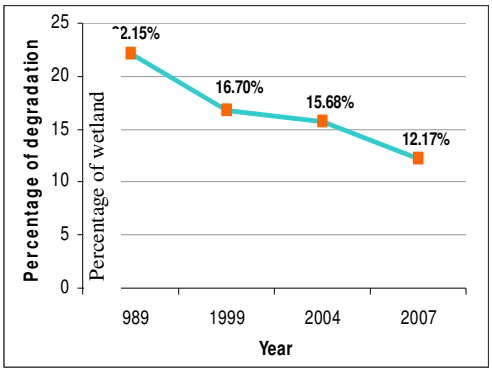
The land uses of the western part of Dhaka are mainly residential, commercial, educational, mixed use, water bodies/low land, restricted area etc. An analysis of the satellite images of Dhaka of 1989, 1999, 2004 and 2007 have indicated that wet lands particularly khals, pond, ditches and low-lying areas have reduced rapidly due to uncontrolled development activities. During 1989-99 time period, loss of wetland was 74.4 ha per year, during 1999-2004, per year rate of loss of wet land was 28 ha and during 2004-2007, about 160 ha of wetland were lost every year. The land use conversion and loss of wetland during 1989 to 2007 in the west Dhaka is shown in Table 3 and Figure 2.

Table 3: Trend of broad land use conversion in the western part during 1989-2007

Land use	Year 1989		Year 1999		Year 2004		Year 2007	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Settlement	10,626	77.85	11,370	83.30	11,510	84.32	11,989	87.83
Low land	3,024	22.15	2,280	16.70	2,140	15.68	1,661	12.17
Total	13,650	100.00	13,650	100.0	13,650	100.0	13,650	100.0

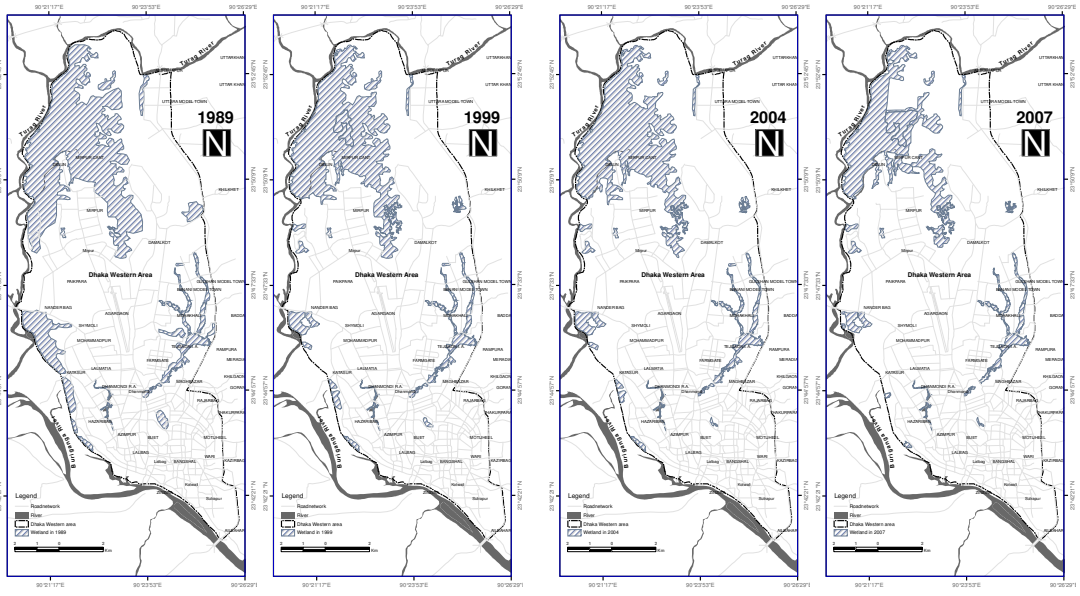
Source: Authors using Remote Sensing Images of TM 1989, ETM 1999, IKONOS 2004 & IKONOS 2007

The trend reflects gradual decrease of wetlands, nearly 22% to 12% over the period 1989-2007. The rate of loss is higher in 2004-2007 due to rapid development of many housing projects in the areas of Bounia, Diabari, Uttara and Katasur. It indicates the lack of control and enforcement of law for wetland preservation by the government, although the Water Body Conservation Act 2004 was prevailing at that time. The conversion of wetland in the study area is shown in Figure 3.



Source: By authors' analysis of Remote Sensing Images

Fig. 2: Decrease of wetland in the West Dhaka (FAP-8B area) during 1989-2007



Source: Authors using Remote Sensing Images of TM 1989, ETM 1999, IKONOS 2004 & IKONOS 2007

Fig. 3: Conversion of wetland in the FAP-8B area (west Dhaka) during 1989-2007

Shrinking of Retention Pond Areas

FAP-8B proposed about 4.5% land area of the western part (136.5 sq. km) as retention pond area. Among the retention sites, Goranchatbari covered about 2.23% of total area and Kallyanpur covered about 2.24% of the study area (FAP-8B area of 136.5 sq. km.). Table 4 shows that during 1989 only 3.14% land area was effective as retention pond and in 2007 this area was reduced to only 1.79%. The analysis reveals that the area of retention ponds was decreased by 60% from 1992 to 2007. During the period 1989-1999, per year loss of pond area was about 8 hectares, in 1999-2004 periods, this rate was about 3 hectares per year and most alarming rate of loss took place during 2004-2007, which was about 29 hectors per year.

Table 4: Shrinking of retention pond areas during 1989-2007

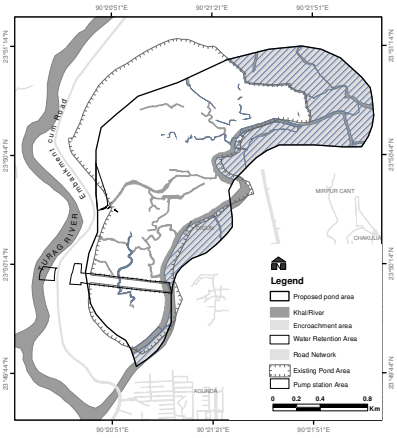
Retention pond area		Effective Retention Pond		Total
		Goranchatbari	Kallyanpur	
Year 1989	Area (ha)	294.90	134.05	428.95
	% of western area	2.16	0.98	3.14
Year 1999	Area (ha)	294.89	52.23	347.12
	% of western area	2.16	0.38	2.54
Year 2004	Area (ha)	294.07	37.32	331.39
	% of western area	2.15	0.27	2.43
Year 2007	Area (ha)	209.89	33.94	243.83
	% of western area	1.54	0.25	1.79

Source: By authors analyzing Remote Sensing Images

Land Use Changes in the Goranchatbari Retention Pond Area

In case of Goranchatbari pond area, government's success in acquiring land area was 274 hectares (99.35% used as pond area) while the required area (based on map) was 304.4 hectare. Aquired area was successfully used as retention pond with pumping facilities. At present, the retention pond site covers about 62% of the initial site, khal area covers another 6%, open space is about 1% and 31% of the designated retention pond area has been converted to residential land use. It has been observed from the Figure 4 that existing acquired land area (274.4 ha) are not same as proposed land area (304.4 ha). But a common area is identified between these two which covers 213 ha (78% area of acquired land) are now being used as pond area (water body).

Figure 5 illustrates that in 1992, during the FAP-8B



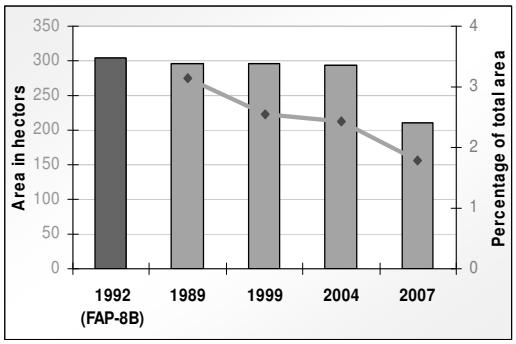
Source: By authors' analysis of Land use map of DAP

Fig. 4: Land use within FAP-8B proposed retarding pond area at Goranchatbari

implementation period, Groanchatbari retention pond area covered about 2.23% area (304.40 ha) of the western part. Satellite image analysis of 1989 clearly states that about 10 ha area of FAP-8B proposal for Groanchatbari retention pond area was already developed as a built up area at that time. Up to 2004, this designated retention pond site was free from illegal encroachment activity but in 2007 about 210 ha (1.54% land of total western area) was found effective which indicates about 29% encroachment of the pond site.

Land Use Changes in the Kallyanpur Retention Pond Area

In case of Kallyanpur pond area, government succeeded in acquiring only 3.2 ha of land, whereas FAP 8B proposed for 306.6 ha of retention pond area. The acquired land 3.2 ha is now using as pump operation area. The existing land uses of the proposed area (306.6 hectares) are presented in Table 5:



Source: By authors using Remote Sensing Images

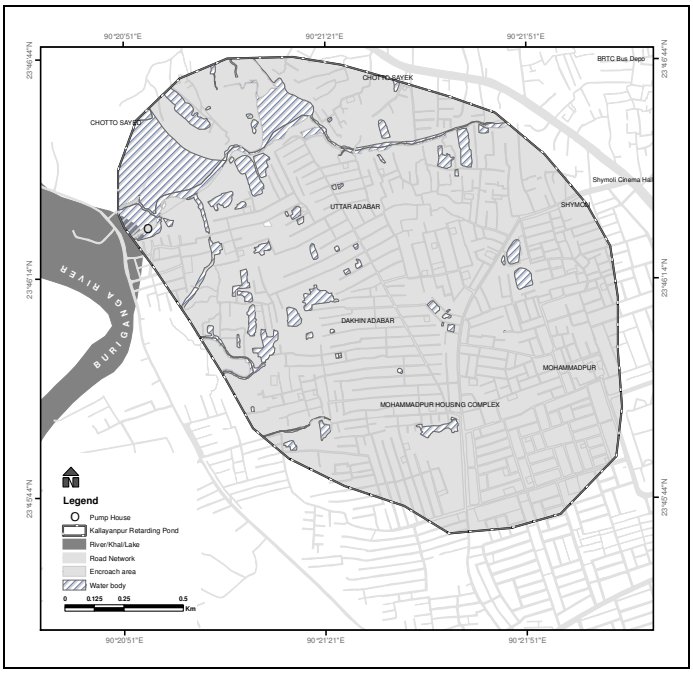
Fig. 5: Goranchatbari retention pond area during 1989-2007

Table 5: Land use within proposed retention pond area at Kallyanpur

Land use	Area in ha	%
Agriculture	10.76	3.51
Commercial Activity	0.94	0.31
Education & Research	6.13	2.00
Graveyard	0.33	0.11
Mixed Use	3.87	1.26
Open Space	0.09	0.03
Residential	233.09	76.08
Transport & Communication	30.62	9.99
Water Body	20.55	6.71
Total	306.38	100.00

Source: Land use map of DAP, 2008

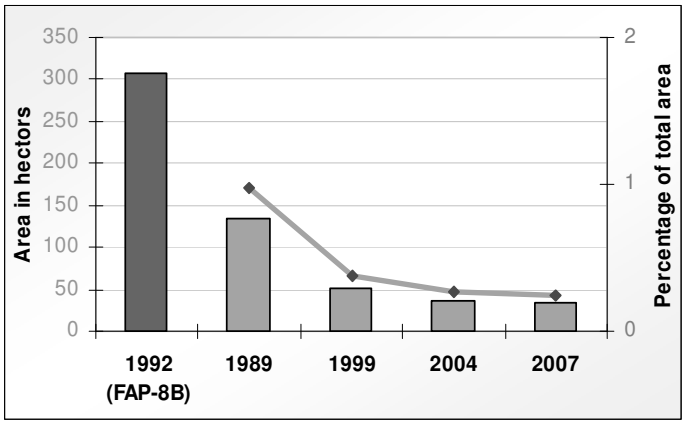
It is observed from Table 5 that most of the lands in proposed area are covered by residential use (76.08%), while only 6.71% are used as water body. This indicates the significant encroachment by the built up areas (private and government housing scheme) which reflects poor effectiveness of Kallyanpur retention area. Among them, 2 public and 12 private housing schemes have been already developed within the retention pond areas at Kallyanpur.



Source: Land use Data Analysis, 2009

Fig. 6: Land use within proposed Kallyanpur retention pond area

During 1992, Kallyanpur retention pond area was proposed for 306.40 ha of land. From analysis of 1989 satellite image it has been found that a significant part of the designated retention pond site was developed with various urban land uses at that time. As a result, government could acquire proposed amount of land for retention purpose. But it was surprising to find that only 3.2 hectares land was acquired to install pumping facilities in the Kallyanpur site ignoring the proposal



Source: Remote Sensing Image Analysis, 2009

Fig. 7: Kallyanpur retention pond area during 1989-2007

of 306 hectares of retention pond. A number of khals were operating in this area during that time which facilitated the drainage function. But later, many of those khals lost their effectiveness due to illegal land filling. Though government acquired only 3.2 hectares of land but about 134 ha of low-lying land in the proposed site has been retaining storm water of the area. These low-lying lands require to be conserved immediately to save west Dhaka from flooding.

Encroachment of Natural Canals (khals)

FAP-8B emphasized on the cleaning and rehabilitation of khals. But, minor initiatives are undertaken by the concern authorities. There are 14 open drainage channels (khals) in the western areas. Some of the major khals have numbers of branches. The catchments areas of the channels vary from 6 to 40 sq. km. Conversion of land from khals to urban uses are common scenario in the western part. It is evident from Table 6 that 13 khals out of 14 khals of west Dhaka are encroached by nearly 50%. Only Ibrahimpur khal is still active without encroachment. Analyzing RS mouza maps and land use maps, the existing use of all khal areas have been identified. Table 6 presents the existing scenario of the major khals in the western area.

Table 6: Existing scenario of the major khals in the western part of Dhaka City

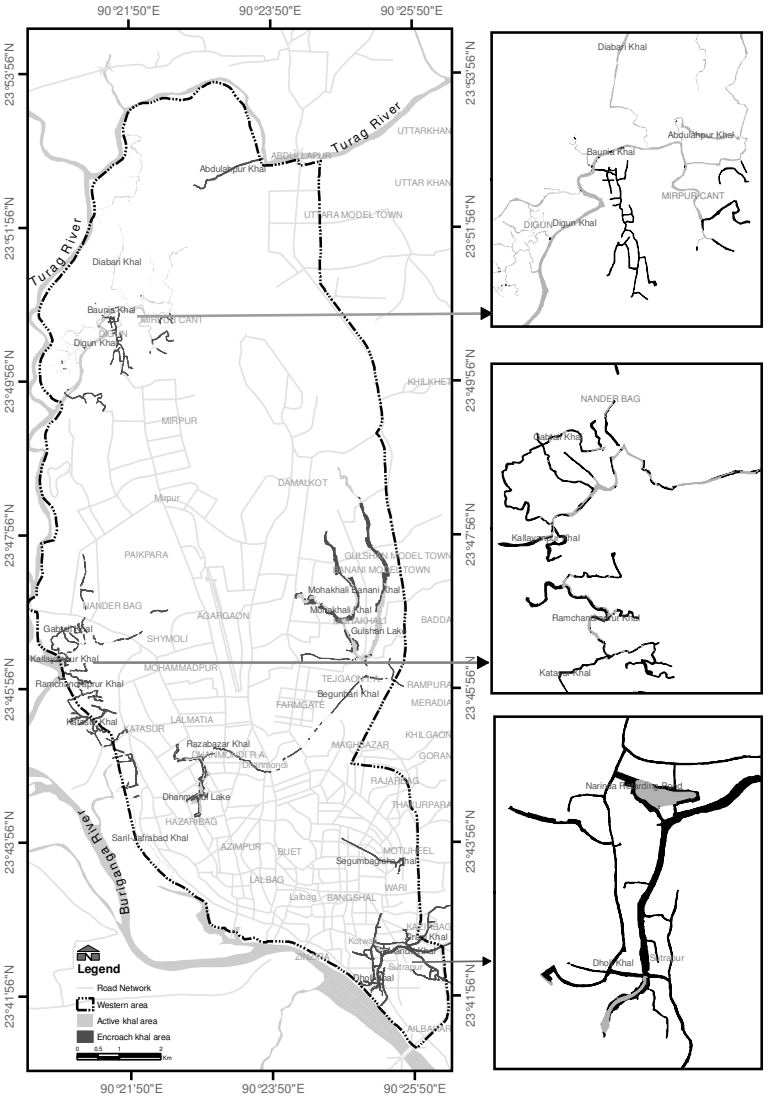
Sl. No.	Name of the khal	Present status	Total Area (ha)	Effective area (ha)	Encroached area (ha)	% of Encroachment
1.	Abdulahpur Khal	The Abdullapur Khal is till now effective. About half of the khal area has filled up and now using as residential purpose. The khal is going to be polluted by residential waste water.	9.99	5.28	4.71	47.14
2.	Baunia Khal	Bounia Khal is active now. Some portion are filled-up for residential development	8.1	6.35	1.74	21.51
3.	Begunbari Khal	Filling up a large portion of Begunbari Khal in Tejgaon, Gulshan and Mohakhali areas.	4.14	2.39	1.75	42.27
4.	Dholi Khal	Dholai Khal has filled up and converted to box culvert. Small portion is used a intake khal for pump station.	9.74	1.26	8.48	87.08
5.	Diabari Khal	Filled up small portion on Diabari Khal by the developers.	31.94	27.66	4.28	13.4

Continued...

6.	Digun Khal	Active as a channel for pumping station of Goranchatbari. Some branches have encroached by developers.	21.93	17.65	4.28	19.52
7.	Gulshan Khal (Lake)	Some portion of Gulshan lake has filled up by Gulshan Residential area.	41.52	28.22	13.3	32.02
8.	Kallyanpur Khal	Major encroachments are found on the Kalyanpur Khal with its six branches in Kallyanpur area.	6.71	3.56	3.15	46.87
9.	Segunbagicha Khal	Segunbagicha Khal is fully encroached by box culvert and construction of road.	1.22	0	1.22	100
10.	Katasur Khal	Encroachments are found on Katasur Khal in Rayer Bazar and Mohammadpur areas.	6.89	2.56	4.34	62.97
11.	Paribag khal	Paribag Khal is filled up though development of road and building.	0.24	0.11	0.13	53.55
12.	Mohakhali Khal	The khal is partially active. Some portion is encroached by the construction of building.	28.15	19.11	9.04	32.12
13.	Ramchandrapru r Khal	Encroachment on Ramchandpur Khal in Islambagh, Nawabganj and Hajaribagh area.	2.37	0.63	1.74	73.41
	Total		172.94	114.78	58.16	33.63

Source: Prepared by authors using data from field survey & secondary sources (RS map and land use map of DAP)

Among them, Segunbagicha khal is no more visible, entirely filled out. An analysis shows that in Dholaikhal, about 45 percent area is now used for transport & communication purpose and about 13 percent area is now used as connecting khal for Dholai Khal pumping station. Figure 8 presents the existing condition of these khals in the western part.



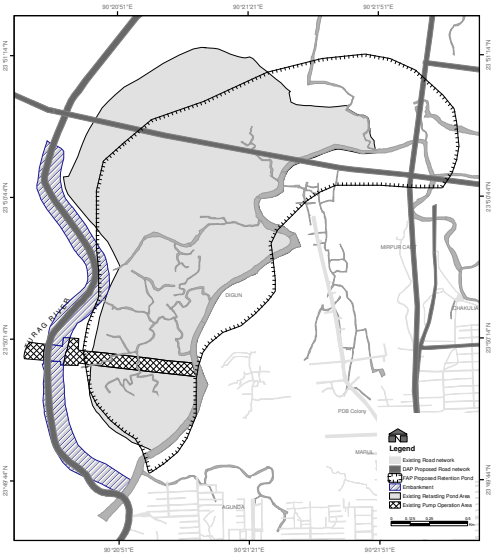
Source: RS map and land use data analysis, 2009

Fig. 8: Encroached areas of the major khals in the western part of Dhaka City

Nearly 34 % khal areas are totally destroyed by the unplanned and illegal intervention of private developers, government as well as the city dwellers, remaining 66 % area is now effective for water circulation. Among the encroached area, about 73% area is occupied by residential activities, 11% for transport & communication and 10% for mixed use. Due to lack of proper physical identification of khals area, the areas have been developed by local inhabitants in residential purpose. Figure 8 shows some of the major khals with encroached areas within the FAP-8B area. Development control and management authorities have no initiatives to safe these natural cannels. On the other hand, road development schemes by the government have significant impact on khal encroachment.

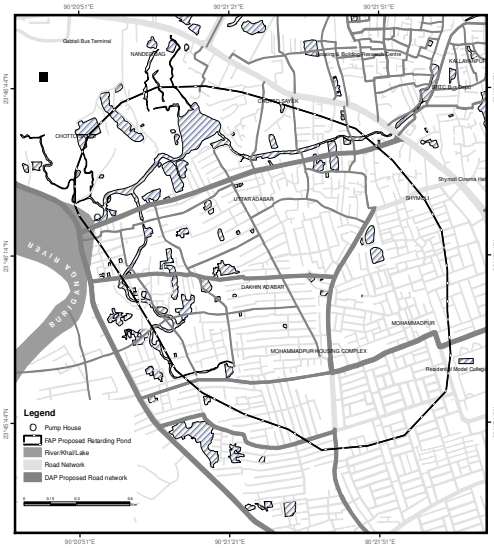
Detailed Area Plan (DAP) and FAP-8B Proposals

The Detailed Area Plan (DAP) has given precedence to eliminate water logging and drainage congestion in Dhaka City. Structure Plan of DMDP 1995-2015 (Dhaka Metropolitan Development Plan) strongly focused on Flood Action Plan (FAP). But DAP under DMDP did not gave due attention to the FAP-8B plan and proposals. It is evident from the study that DAP has proposed a number of infrastructure development works within retention pond areas of FAP-8B proposal. Figures 9 and 10 present DAP proposed roads through the Goranchatbari retention pond site comprised of an area of 10.4 acre. Similarly, road was proposed inside Kallyanpur retention pond area which covers about 42.93 acres of land. These road projects of DAP required to be studied for the impact assessment on the drainage and flood control measures of FAP-8B.



Source: Physical feature and land use data analysis, 2009

Fig. 9: DAP's road network proposal in Goranchatbari retention pond area



Source: Physical feature and land use data analysis, 2009

Fig. 10: DAP's road network proposal in Kallyanpur retention pond area

Recommendation

Based on the findings of the research, the following measures can be adopted for comprehensive management of retention pond areas and khals to minimize the suffering of the city dwellers from physical, social, environmental, and economic points of view.

Development Control to save Retention pond, Natural Drainage and Water Bodies

- The concerned authorities like RAJUK, DCC, DWASA, BWDB etc. should take appropriate measures immediately to protect retention pond, wetlands, low lands, natural canals, khals, water bodies and rivers in and around the city area for its survival.
- There should be a clear demarcation of the retention pond areas, khals, water bodies in maps and plans.

- Many khals and lakes are still being retained. As a result, if strict measures are taken, it is still possible to maintain effective and well-functioning natural drainage system.
- The authority should apply existing laws and regulations and take immediate legal action against the violators of the planning rules and regulations.

Multipurpose use of Retention Ponds to Control the Land Use

The policies of DMDP Structure Plan (1995-2015) regarding the use of retention pond areas required to be followed strictly. The use of land within designated retention pond areas to be restricted with: 1) Agriculture, 2) Fish cultivation and 3) Recreation. Goranchatbari retention site is well managed with cultivation and fish culture activities.

Drainage Capacity Adjustment

- Review and demarcation of (water bodies) retention pond areas for Kallyanpur and immediate need of land acquisition.
- Remaining water bodies in the western part of Dhaka must be protected from any sort of development.
- All encroached khals in the western part must be excavated to improve drainage network.

Comprehensive Drainage Development Plan

- There should be a comprehensive storm water drainage development and improvement plan.
- The proposed comprehensive drainage improvement plan required to be consulted with other utility organizations to avoid contradiction and overlapping.

Improvement of Drainage Management System

- The concerned authorities should ensure regular and careful maintenance of all the interconnected secondary and tertiary drains through proper monitoring program.
- Inspection at regular interval should be made on storage of construction materials and any sort of illegal affairs causing blockage of drains.
- Steps should be taken to rehabilitate the natural drainage system.

Conclusion

Unplanned land development, especially the encroachment of retention ponds, canals and low-lying areas is alarming for Dhaka considering the urban flooding, particularly at the backdrop of climate change. Urban flooding would be the unavoidable consequence of climate change impact. The findings of this research reveal the devastating scenario of loss of designated retention pond areas and canals in the protected western part of Dhaka. It is worth mentioning here that eastern Dhaka is also planned to be protected by embankment, keeping sufficient retention pond areas and canals with pumping facilities. The learning from the west part required to be kept in mind while determining planning tools and strategies to protect retention sites in the east Dhaka. The findings of this research reveal that Goranchatbari site is comparatively better managed than Kallayanpur and Dholai Khal sites.

Acknowledgment

First and foremost, we would like to express our gratitude to the consulting firm "Ganibangla Ltd." for providing us the required data. Also sincere gratitude goes to all the authorities of different development organizations (RAJUK, DCC, DWASA and BWDB), all the experts in related field and general people living in different parts of the city that provided us with important information, helpful discussion and explanation, and valuable suggestion during the field work. We would like to express special gratitude to A.S.M Mahbub-un-Nabi (Professor, Department of Urban and Regional Planning, BUET) for his inspiration to undertake this research.

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