

## Effects of Flood Mitigation Measure: Lessons from Dhaka Flood Protection Project, Bangladesh

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### Introduction

Although, Bangladesh is subjected to perpetual floods every year, she suffered two of the most serious and devastating floods on record in 1987 and 1988 which lasted from later part of August to first part of September. Vast areas of the country including the Capital City of Dhaka with a population of about 4.8 million were flooded to an unprecedented degree with flood levels 1.5 m higher than normal for periods up to four weeks. In Dhaka City, it is estimated that about 200 sq km (77 per cent of the total area of 260 sq km) was submerged to depths ranging from 0.3 m to over 4.5 m (FAP 8B, 1991). About 2.4 million people (50 per cent of the city population) were directly affected by these floods. Conservative estimates of the floods suggest that loss due to annual flood is about Tk<sup>1</sup> 250 million, and the damages to a 10-year (return period) flood and a 40-year (return period) flood are Tk 530 million and Tk 750 million, respectively (Bangladesh Water Development Board, Undated).

Following the floods of 1988 the Government of Bangladesh (GOB) established a National Flood Protection Committee in October 1988 which proposed to build a system comprising of embankments and flood walls around Dhaka City to protect the intrusion of flood water from the surrounding rivers and drain out the internal water caused by rainfall. This system is known as "Dhaka Flood Protection Project" (DFPP). At the same time, the Government of Bangladesh also formed a special organization called the "Committee for Flood Control and Drainage of Greater Dhaka" (CFCDGD) with the primary objective of preparing a flood control plan for Greater Dhaka City. In January 1989, the CFCDGD submitted a detailed scheme for phased flood protection and drainage for Dhaka and its surrounding areas which was approved by the Government in March 1989.

Meanwhile, the catastrophic flood disasters in Bangladesh led to formation of a unique

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<sup>1</sup> US\$1=Taka 41 (approximately)

“global program” for assisting Bangladesh in management of its national flood control problem, involving participation by many international assistance agencies. In institutional terms, Bangladesh’s flood problem became internationalized as these publicly expressed concerns became translated into a number of studies and planning documents commissioned by the UNDP/GOB, France, USAID, Japan and others (Adnan, 1991). In July 1989, the G-7 summit in Paris issued a ‘communiqué’ which endorsed the World Bank’s role as coordinator of a massive plan to control the floods and their damages in Bangladesh. Hence, a Flood Action Plan (FAP) was formulated for the whole country under the coordination of the World Bank in November 1989 as the summit of G-7 called for:

effective, coordinated action by the international community in support of the Government of Bangladesh in order to find solutions to this major [flood] problem which are technically, financially, economically and environmentally sound.

Following an initial conference held in London in December 1989, a second meeting was held in Dhaka on January/February 1990 for the purpose of delineating FAP. The overall FAP, totalling an estimated Tk 400 billion included a total of 11 components and 15 supporting activities to be taken up over a five-year period as a long term plan of physical works and improved preparedness and management of floods. But, *the then Government of Bangladesh had gained power without free and fair elections and the FAP was not ratified by a legitimate parliament* (Hughes, Adnan and Dalal-Clayton, 1994).

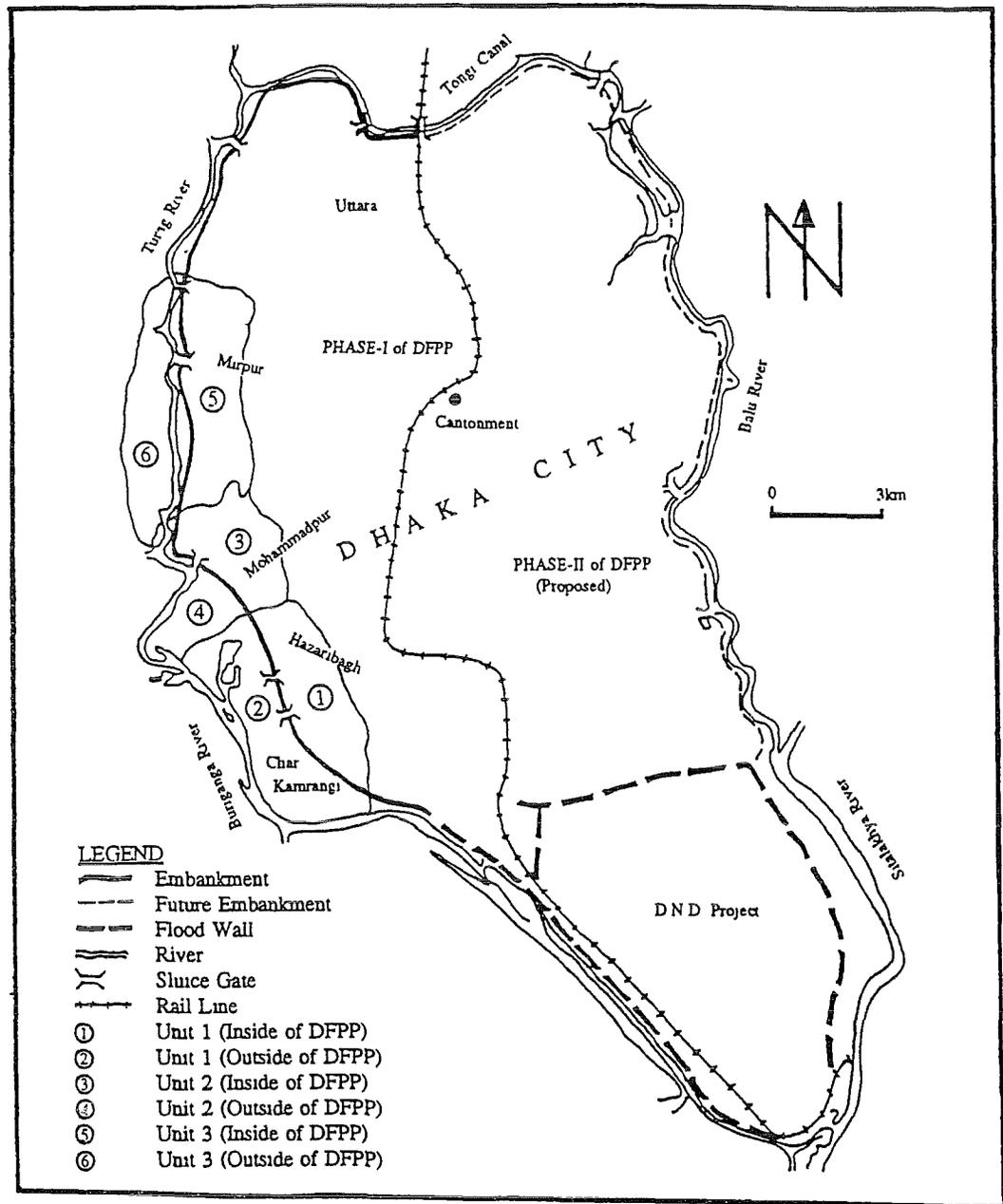
In view of the high priority assigned to the Dhaka protection scheme, the Government of Bangladesh immediately initiated the Phase-I of DFPP proposed by the National Committee on emergency basis using its own resources without waiting for the Flood Action Plan proposed by international agencies. After introduction of FAP, it has included the DFPP as one of its main components which was actually started before the initiation of FAP.

### Study Area and Methodology of the Research

This study was conducted from January to August 1995 and covered the western fringe areas of Dhaka City which stretches from Kellar Morh to Shirnir Tek. The whole study area was divided into three units viz. (1) Hazaribagh (Kellar Morh to Hazaribagh) Unit, (2) Mohammadpur (Satmasjid Road to Kallyanpur Canal) Unit, and (3) Mirpur (Mirpur Bridge to Shirnir Tek) Unit (Fig. 1). Each unit was again divided into two sides i.e., inside and outside of the embankment. Thus, a total of six areas were included in this study (three from inside and three from outside). The reason behind selecting these areas is that all of them were highly flood prone before construction of DFPP.

Based on the displacement of the people by the construction of DFPP and its effects on various socio-economic and environmental aspects, the settlers were classified into four groups, i.e., (1) settlers who have been living inside the embankment since before its construction, (2) the people who migrated to the protected inside area after the project, (3) people who have been living outside since before the construction of the embankment, and (4) the new migrants to the outside area after the project. All the settlers of the above mentioned groups were considered as target groups of the study as they all are affected by the construction of the embankment. Total number of respondents was 90 of which 54 were selected from the inner part and the rest 36 were from the outer part of DFPP. The techniques used for this research were reconnaissance survey, field observation, questionnaire survey and laboratory test. A total of 15 hypotheses were set to detect the effects. The data were analysed and the hypotheses were tested through various statistical tools such as T-test, Z-test, Chi-square test and simple statistics like frequencies, percentage, mean etc.

**Figure 1**  
**Location of the Study Areas**



### **Effects on Some Economic Aspects**

The economic condition of an area, region or a country not only depends on any single parameter but also on several socio-economic factors which normally have complex interrelationships among each other. Effects of DFPP on some economic aspects are discussed below:

#### ***Primary Occupation***

There is a tremendous effect of DFPP on the primary occupation of the people in its fringe areas mainly in the outer part. The highly affected areas are the outer parts of Hazaribagh and Mohammadpur where the soil nutrients of the agricultural lands (one time paddy cultivation per year) are already destroyed because of polluted water flowing from the Tannery Industries inside (in unit 1 and unit 2) of DFPP. Polluted water with residue from Tannery Industries enters canals and rivers outside the DFPP through a few number of sluices which has hampered the assimilative capacity of these manmade or natural flows. Due to the infiltration of water, the ground water has also been polluted in the fringe areas of DFPP. Hence, the soil nutrients are destroyed and the land has lost its fertility to grow any type of crop prompting the residents to shift from agriculture to other jobs. The situation of the outer part of Mirpur Unit is a little bit different from these two units where the farmers are still engaged in agriculture as there is no polluting industry in or outside of the embankment.

Field survey shows that 21.1 per cent respondents were engaged in agriculture before the construction of DFPP among which 16.7 per cent were in the outer part and 4.4 per cent were in the inner part of DFPP. But, after the construction of DFPP, the total figure has become 6.7 per cent which exclusively belongs to outer part of DFPP mainly of Mirpur area. For the outer part of the other two units, the people previously engaged in agriculture are currently engaged in boat rowing or daily laborer. On the other hand, farmers in the inside area have shifted to business or taxi driving. Another major change in occupation can be seen in case of boat or taxi driver. Before the construction of DFPP, a total of 8.9 per cent respondents were occupied in these jobs among which 7.8 per cent (belonging to inside area) were engaged in taxi driving while only 1.1 per cent (belonging to outside area) were engaged in boat rowing. But, after the construction of DFPP, the total figure has reached to 15.6 per cent. Out of this, 5.6 per cent respondents (belonging to outer part) are boat rowers and 10.0 per cent (belonging to inner part of DFPP) respondents are engaged in taxi driving.

Even though the respondents of the inside area aired that they are happy with their current occupation, there is a high level of dissatisfaction among the respondents of outer part with their changing and new occupation. The reason behind this is that the main occupation of most of the insiders have not changed with the construction of DFPP i.e., the changes are not statistically significant. Further more, the people whose main occupation has been changed still can earn the adequate amount of money for living expenses.

#### ***Income***

Average income of the respondents inside of DFPP is increased after the construction of DFPP from Tk 5342.59/month to Tk 6800.93/month while that of the respondents outside of the embankment has been decreased from Tk 4975.00/month to Tk 4933.33/month which is not statistically significant. As a whole, the average income figure has been increased from Tk 5195.56/month to Tk 6053.89/month after the project. The reason behind the increase in average income for total respondents may be that though the average income of outsiders has been reduced, the reduction is only Tk 41.67/month while the increase in income for the insiders is Tk 1458.34/month.

Another investigation regarding the respondents attitude towards the change in income reveals that income of 34.4 per cent respondents has been reduced while only 16.7 per cent has been increased after the project. The 48.9 per cent respondents answered that their income remained unchanged. The investigation shows that 77.8 per cent respondents of total 36 outsiders answered that their income is reduced after the project while the figures are only 2.8 per cent and 19.4 per cent for increased or unchanged income, respectively. But, a fully different picture can be observed in case of insiders where only 5.6 per cent respondents (out of 54) claimed that their income is decreased after the building of DFPP. On the other hand, 25.9 per cent people are enjoying increased income leaving a wide space for 68.5 per cent insiders whose income is unchanged. Furthermore, the distribution of income has been changed in both sides of the embankment after its construction. While the percentage of people belonging to income groups of Tk 2000-3500, Tk 3501-5000, Tk 5001-8000 and Tk 8001-10000 were 34.4, 32.2, 22.2 and 7.8 respectively before the project was implemented, the percentages for the same variable after the project are 17.8, 31.1, 33.3 and 11.1 respectively.

### ***Expenditure***

The average expenditure of both sides has been increased after the construction of DFPP. While the average expenditure for the insiders before and after the construction of DFPP are Tk 5201.85/month and Tk 6592.59/month, respectively; the values of Tk 4805.56/month and Tk 5116.67/month have been registered for the outsiders. The average expenditure for all respondents has been increased from Tk 5043.33/month to Tk 6002.22/month. These figures express that while the increase in expenditure for the total area and for the insiders are statistically significant, it is not true for the outsiders. It means that there is an increase in expenditure for the outsiders, but it is not too high from the situation before DFPP was built.

The analysis of data shows that there is a change in the distribution of expenditure level among the insiders, but there is no such difference among the outsiders between before and after the construction of DFPP. This is supported by the opinion of the respondents as 85.6 per cent of the total 90 respondents claimed that their average expenditure has been increased and rest 14.4 per cent respondents bestowed their opinion in favor of unchanged expenditure. Almost same proportion of respondents (85.2 per cent and 86.1 per cent for insiders and outsiders, respectively) agreed on increased expenditure. Not a single respondent whether in the inside or outside of DFPP agreed that their present expenditure is less than that of before the construction of DFPP. Thus, it can be concluded from the people's perception that the average expenditure is higher now than it was before the construction of DFPP.

### ***Over all Economic Condition***

The research reveals that before the construction of DFPP the average expenditure of the people was less than their average income (Table 1) though the difference was not very high. It means that before implementation of the project, the people of both sides of the embankment could afford their household expenditure from their income though it was almost impossible to save any remarkable amount of money.

But, the "situation after" the project shows that the saving features for the insiders of DFPP and for total area are positive while it is negative for the outsiders. The main reason behind the negative saving of the outsiders may be due to the meager salary earned for the change of their main occupation from agriculture to a daily laborer and boat rower. *Question may be asked on how the outsiders can lead their lives with negative savings? The respondents expressed that the poor outsiders are selling their lands and affording the extra expenditure from that money. After some days, when it becomes impossible to manage the extra expenditure, the poor sell their*

*whole lands and shift back to their original rural villages* The slightly positive figure for savings for the whole area after the construction of DFPP indicates that the poor situation of outsiders is complemented with comparatively better situation of the insiders. In brief, the economic condition of the outsiders is in a worsening direction after the construction of DFPP while the situation for the insiders is just alright.

**Table 1**  
**Effects of DFPP on Overall Economic Condition of the People in Its Fringe Areas**

Economic Aspects	Unit	Before Construction of DFPP			After Construction of DEPP		
		Inside	Outside	Total	Inside	Outside	Total
Income	Tk/month	5342.59	4975.00	5195.56	6800.93	4933.33	6053.89
Expenditure	Tk/month	5201.85	4805.56	5043.33	6592.59	5116.67	6002.22
Savings	Tk/month	+140.74	+169.44	+152.23	+208.34	-183.34	+51.67

Though, the outcome of this research indicates the facts described in previous paragraphs, *it can not be claimed that the construction of the embankment is the sole reason for current situation*, because the study areas (mainly inside of DFPP) are directly affected by the economic situation of the country. In fact, *the socio-politico-economic factors (which includes micro economic factors like inflation rate of the country, unstable political condition leading to unstable economic condition) in addition to the presence of the embankment are the main reasons for changed economic situation of the insiders. But, the worsening economic condition of the outsiders can be attributed to the building of the embankment to a greater extent. For them, (i) the transportation cost of any activity has been increased due to the barrier caused by the embankment, (ii) occupation has been changed due to the water pollution and depletion of soil nutrients (true for Hazaribagh and Mohammadpur unit), and (iii) more vulnerability to floods has decreased the value of their lands. These factors along with national economic factors can be attributed to the current economic condition of the outsiders of DFPP.*

### Effects on Some Environmental Aspects

#### *Waste Disposal System*

In the inner part of the embankment both point and non-point sources of domestic wastes and industrial wastes are generated. Point source domestic and industrial wastes are disposed off into the sewer lines where as the non-point source wastes generated from enormous number of slums are disposed off into the open low-lying water bodies. Eventually, these wastes are carried out by surface run-off to the low-lying areas just inside the embankment. Before the construction of the embankment, these wastes could be disposed off directly to the nearby rivers through many disposal points. In this case, the river flow could use its assimilative capacity to purify the wastes and could carry the wastes to the downstream location. But, after the construction of DFPP, there are 10 sluices starting from Kellar Morh to Tongi Railway Bridge for disposing the wastes to the rivers. It takes two to four days to dispose the wastes (solid waste mixed with liquid run water accumulated in the low-lying ponds) to the rivers. This character of waste disposal system has made the stagnant low-lying water bodies as '*low-lying mixed (waste and water) waste bodies*' which has been worsening by the disposal of human excreta of the slum dwellers who are

approximately 25 per cent to 30 per cent (Centre for Urban Studies, 1988) of the city population. The human excreta comes in contact with the stagnant water and remains there for a couple of days until being pumped out. This is causing surface water pollution of ponds and lagoons. Then through infiltration, it is polluting the ground water. People in the adjoining areas are using water from the stagnant water bodies for their daily use as they are not served by the water supply of Dhaka Water and Sewerage Authority. In all of the three study areas of the outer part of DFPP, no waste disposal system is provided by Dhaka City Corporation or any other organization. People in these places use service latrines as well as septic tanks from which the wastes are accumulated in low-lying areas. People residing beside the rivers dispose off their solid wastes directly to the rivers.

The investigation reveals that about one-fourth insiders assured that they were getting waste disposal service while three-fourths answered negatively. For the outsiders, 100 per cent claimed that they did not get any waste disposal service from the government. For the total respondents, only 14.4 per cent answered positively while 85.6 per cent respondents answered negatively. In brief, the construction of DFPP has caused severe adverse effect on waste disposal system in its fringe areas leading to create other related environmental problems

### *Water Quality*

Before the construction of DFPP, Dhaka City was served by a number of natural drainage canals which used to collect waste water from the whole city and discharged into the nearby rivers through various disposal points. These canals act like recipient bodies for storm sewage, septic tank effluent, bucket latrine wastes, uncollected garbage deposition, urine and faeces from service latrine (for the slums) and open defecation area, street wash carrying leach from solid waste and sewer line overflow from manholes. Because of the receiving of different kinds of polluted water, the canal water is heavily polluted. But, the construction of DFPP has disrupted this system due to its 'planned water regime' theme for discharging water to the rivers outside the embankment through ten sluices in the dry season and five pump houses in the rainy season.

At present, the polluted water remains stagnant in the low lands in the inner fringe areas of the embankment from two to four days before being pumped out to the rivers outside the embankment. In the rainy season, the situation becomes more critical. Due to the construction of unplanned houses in the fringe areas of DFPP, virtually there is no canal or drainage system in the fringe areas and the internal canals and drains end at the low-lying water bodies just inside the embankment. So, during the rainy season internal flood water from the canals and drains overflows the plain land and huge amount of flood water reaches five pump houses which is higher than their normal discharging capacity. In this case, the fringe areas of DFPP are flooded not only by river water but also by internal rain water which takes a long time to be discharged outside through the pumps. The retention of polluted water causes surface water pollution in the fringe areas which finally creates health hazards when the poor people use this water for household consumption.

As the polluted water flows to the rivers through few pump stations during flood season and some sluices during dry season, it is creating severe point source pollution to the rivers outside the embankment. Because, in this case, the river water cannot utilize its assimilative capacity. Mainly the water of river Buriganga at Hazaribagh and Mohammadpur Units has become unusable and the aquatic life is almost destroyed. The test<sup>2</sup> results of different parameters of water bodies in the fringe areas of DFPP (Table 2) show that, except the pH values of all four water bodies and the value for color of Buriganga river water, all others are tremendously higher than

<sup>2</sup> The tests were conducted during February and March 1995

the standard values for Bangladesh. For example, the standard values for BOD<sub>5</sub> for the drinking and fishing water in Bangladesh are 0.20 mg/l and 6.00 mg/l, respectively. But, the values for the same parameter for Buriganga River, Turag River, Hazaribagh Canal and Kallyanpur Canal are 72.00 mg/l, 52.00 mg/l, 670.00 mg/l and 141.00 mg/l, respectively. It means that for drinking and fishing water normally the requirement is only 0.20 mg/l and 6.00 mg/l of oxygen to oxidize organic matter, whereas the requirement for these four water bodies are enormously high. Same situation prevails for other water quality parameters like COD, turbidity, and color for the four surface water bodies.

**Table 2**  
**Test Results of Water Quality of Some Water Bodies in the Fringe Areas of DFPP**

Parameters	Unit	Bangladesh Standard		Test Results			
		Drinking water	Fishing Water	Buriganga River	Turag River	Hazaribagh Canal	Kalyanpur Canal
pH	—	6.5-8.5	6.5-8.5	7.40	7.40	7.30	7.35
Color	Hazen Unit	15	Normal	15.00	22.00	330.00	140.00
Turbidity	NTU	10	NYS	22.00	57.00	37.00	27.00
COD	mg/l	4	NYS	77.00	66.00	710.00	155.00
BOD <sub>5</sub>	mg/l	0.2	6	72.00	52.00	670.00	141.00

Note . NYS = The Bangladesh standards for these parameters are Not Yet Standardized

At present, the situation is worst in Char Kamrangi and Basila (outer part of unit 1 and unit 2) while the situation of Mirpur area (both in and out side of the embankment) is almost unchanged. *The people of Basila and Char Kamrangi claimed that after the embankment is constructed, they can not use the surface water from Buriganga River and Hazaribagh Canal for their household consumption. The fishes of these two water bodies had disappeared in the last three to four years.* The black color and intolerable bad smell of these two water bodies testify the claim of water pollution. Both water bodies are polluted due to the disposal of polluted water from whole Dhaka City as well as from Hazaribagh Tannery Industries. The water of Turag river is polluted in the same way but not by the wastes from Tannery Industries. Rather, it is polluted by the construction of brick fields at the river bank and by waste water from all western part of Dhaka City through Kallyanpur Khal. On the other hand, the water of Kallyanpur Khal which lies inside the embankment is polluted due to its carrying character of waste materials and water from different parts of the city.

### Effects on Land Use

The three basic criteria for controlling the land use pattern from one form to another are (1) land demand, (2) land price and (3) landholding size. Land price depends on land demand, and demand is in turn dependent on land status and direction of regional development. The effects of DFPP on the above criteria as well as the current and future land use pattern are discussed below.

### *Land Demand*

After building of the DFPP, the areas inside the embankment which normally were used to be flooded seem to be free from flood risk at present. It is leading to the development of the fringe areas provided that better communication facilities, water supply facilities and other urban services would be available in the near future. Many housing estate agencies are working like a boom for developing the newly flood free areas in and around the fringe areas of DFPP. Automatically the land demand has been increased because the people from all over the country are trying to have at least a small plot of land in the flood free capital of the country with the hope of better urban facilities. On the other hand, the presence of DFPP has made its outer part more vulnerable to flood than before the project was implemented. This incident as well as the barrier caused by the embankment itself has worsen the communication and other facilities of the outer part. As a result, the demand of land of this side of the embankment has been decreased. Combining both sides of DFPP, the demand of land has been increased after the construction of the embankment which is dependent on the location.

The research indicates that 68.9 per cent respondents (all are from inside) ensured the claim that the land demand has been increased after the construction of DFPP while 31.1 per cent respondents who were from outside denied the claim. A total of 36.7 per cent respondents opined that the main reason for increasing land demand is the flood free character of the inside area of the embankment. Development of communication has become the second reason which is supported by 13.3 per cent respondents.

### *Land Price*

Aside from the change in demand, land prices of the whole area have an increasing trend (Table 3) which is statistically significant and also true for the inner part of the embankment. Contrary, the average land price outside the embankment is in decreasing direction.

**Table 3**  
**Land Price of the Study Area in Different Years (Tk/acre in '000)**

Year	Inside of DFPP			Outside of DFPP			Total		
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
1986-90	1500	4800	2726	900	1800	1247	9000	480	2135
1991-93	3300	9000	5473	420	8000	683	420	9000	3557
1995	9000	18000	12869	300	15000	768	300	18000	8029

These findings were supported by the respondents' claim which express that the effect of DFPP on land price is location dependent. About 96.3 per cent insiders claimed that the land price is increased while 97.2 per cent outsiders mentioned that the land price is decreased. Now, the renters or buyers are paying more for a piece of flood free land (inside of DFPP) to have other urban facilities. On the other hand, the owners are selling their lands for higher profit. Housing estate agencies are playing a great role in this game. But, the situation of the outside area is different. As the people cannot cultivate any crop or can not use their lands for any purpose, their price is decreased after the project. The housing estate agencies are taking advantage of this situation by investing on these lands for future use.

### *Landholding Size*

Due to the combined effects of DFPP on land demand and land price, the average landholding size is in decreasing trend. Whereas, the average landholding sizes of the inner part, outer part and the whole area were 2.01 acre, 1.65 acre and 1.87 acre respectively before the construction of DFPP, the values for the same are now 1.06 acre, 0.62 acre and 0.87 acre. This means that the current landholding size is very low which is about half of the size of that before the DFPP was constructed.

The decreasing size of landholding caused decreasing number of residents with large landholding. For example, landowners with more than 0.50 acre decreased from 45.60 per cent to 23.40 per cent. The high demand inside the embankment prompted the owners to sell their lands resulting in decreasing the amount of land per capita. Though there is a lower demand on the outer part of the embankment, the housing estate agencies are buying these lands with a very low price with the hope that in the near future the demand will be higher. The study also reveals that average landholding size of 66.7 per cent respondents is decreased, 13.3 per cent is increased and 20.0 per cent is unchanged.

### *Land Use Pattern*

The effects of DFPP on land demand, land price and average landholding size finally have effects on the land use pattern-increase in residential land and a decrease in agricultural land. There is a slight rise in the commercial land use also. Respondents of inner part are comparatively less satisfied with the present land use pattern than the outsiders.

Based on the current land use pattern, 82.2 per cent of the respondents perceived that in the near future the fringe areas of DFPP (both in and out side of DFPP) would be developed into purely residential nature instead of its previous agricultural use. They opined further that only a limited area would be used for commercial purposes in both sides of DFPP and a small portion of outer part would be used as agricultural land. The main reason for this prediction, as expressed by 43.0 per cent respondents is the flood-free character of the inner part.

Better communication facility is also being provided by the government without adequate drainage or sewerage facilities. The residential plots are developed individually or by housing estate agencies in a haphazard manner without the provision of central drainage or sewerage plan which has already started to create internal flood due to drainage congestion. About 85 per cent of the respondents from the outer part of the embankment opined that though they are not in flood-free zone, the areas would be used mainly for residential purposes because of better communication link with the main city (in the future) and loss of fertility of agricultural lands. For them, another reason behind future land use forecast is that the people are concerned to have lands near Dhaka City believing that the floods like 1987 and 1988 occur once in every 100 years or so.

### **Effects on Settlement Pattern**

The change of land use from agriculture to residential nature and the redistribution of the income groups have created severe effects on settlement pattern in the inside but not much on the outside of the embankment. Due to the flood-free character of the inner part, new construction boom has been started. Since, currently the outer part is more flood prone, the effects on settlement pattern on it is less than that of the inner part. The study shows that the proportion of temporary houses has decreased from 33.3 per cent to 20.0 per cent while the permanent and semi permanent houses have increased (mainly in the inner part of DFPP) from 22.2 per cent to 26.7 per cent and from 25.6 per cent to 33.3 per cent, respectively after the construction of DFPP.

Currently, the density of settlement is increasing at a very high rate brought about by the migration rate. The trend shows that the middle income groups are likely to contribute the high density of settlement and is supported by 57.8 per cent insiders and 71.1 per cent outsiders. Only about one-fourth of the insiders mentioned that this area would be a residential place for high income group while almost same proportion of outsiders told that the outer part of DFPP will be a place for low income groups. As a whole, about three-fourths of the respondents answered that the middle income group of people will live in the fringe areas of DFPP. The reason behind this is that the low income groups are unable to make place in these areas due to high price of land. Though, at present temporary settlement of landless and low income groups are present in many places throughout the fringe areas, ultimately they would be forced out by settlers of middle income groups. On the other hand, the high income groups would not be interested to settle in these areas due to the haphazard development plan and absence of sufficient urban facilities.

### **Effects on Severance and Resettlements of the Land Losers**

The creation of the embankment has caused difficulties in accessing into riverside activities mainly in the business activities. It is found from this study that a total of 26.7 per cent respondents lost their lands for the construction of DFPP of which 2.0 per cent lost their lands on both sides. This supports the findings of Azam (1990) which shows that out of 1040 persons interviewed 227 persons (21.83 per cent) had lost their land due to construction of the embankment. This caused severe severance problem after the construction of the embankment. Currently, there are few people who have their lands in both sides as most of these 26.7 per cent people had sold their lands in one side or both but with low price.

There were cases regarding maltreatment of residents who lost properties for the building of the embankment. The legal basis for acquisition of property for the DFPP is the 1989 bill passed in the National Parliament which calls for consideration to be given for compensating the owners for their land at market value and for damages to standing crops or trees, severance from the owners other properties or earnings, and for expenses for relocation of residence and business. In contrary, sometimes, the practice was to force out the landowners with a price less than market price and furnishing them with a meager or nothing for rehabilitation cost (cost of shifting to another place and lost income before becoming re-established in gainful employment).

Survey results (Table 4) show that all of the land losers were compensated of whom about one-fourth were paid whether less than market price or a very marginal price. The ratio between the prevailing market value and the rate of compensation paid varied from 2 to 6 times. Another reason for low compensation rate is that the landowners commonly declared lowered value of their lands in the registration documents to reduce the stamp duties. But, in many cases it was claimed by the respondents that the illiterate people were influenced by the dishonest government employees to do this and be cheated later on.

### **Extra Damage Outside the Embankment**

While the creation of DFPP has become a blessing for the people inside of the embankment as well as for the economy of the whole country, it is a social, economic and environmental curse for the area and people outside the embankment. Though the country did not face any severe flood after the construction of DFPP, the evaluation of Bangladesh Water Development Board of extra flooding west of the embanked area (the study area of this research) estimated that extra water rise at peak flood would be from 1.0 m to 1.5 m which means that the outer part of the embankment

will experience a severe flooding situation even if the intensity is far below than that of 1988. To explain the severity of damage outside the embankment it is appropriate to quote from "Initial Environmental Examination for Dhaka Flood Protection Project" DOE, October 1989 which states that,

According to the DFPP plan, flooding of Dhaka inside the dikes will be allowed to occur up to some specified limit beyond which gates would be closed, in order to achieve an optimal balance between damages which will occur within the protected area and extra damages to the communities, agriculture, fisheries and other values outside of the embankment. The need is for an economic evaluation of the savings versus losses at various control height so that an appropriate plan can be prepared to compensate the losers who are disadvantaged by the project

The construction of DFPP has created psychological fearness among the outsiders because they feel more flood prone after its building. The respondents inside the embankment have positive attitudes with the embankment but the outsiders have negative attitudes. This negative attitude towards DFPP may lead them to sabotage the whole embankment after they face one severe flood season in the future.

**Table 4**  
**Status of Compensation to the Land Losers (Among the Respondents)**

Location	Very Marginal Price		Lower than Market Price		Equal to Market Price		Higher than Market Price		Total Landlosers	
	No.	%	No.	%	No.	%	No.	%	No.	%
Inside	1	3.0	5	15.2	12	36.4	1	3.0	19	57.6
Outside	0	0.0	2	6.1	11	33.3	1	3.0	14	42.4
Total	1	3.0	7	21.3	23	69.7	2	6.0	33	100.0

### Conclusion

The water resources development including flood management has been and will continue to be a key factor in the economic development of Bangladesh. Failure to utilize the water resources in an integrated, balanced and comprehensive manner will not only cause stagnation in growth, especially in agricultural sector but also will give rise to many environmental problems (Nishat, 1993). Actually, living with floods and doing nothing cannot be an acceptable alternative to the people in a country struggling to be developed. But, it does not mean that an immense structure like DFPP would be planned and constructed without a feasibility study despite the negative attitude of a governmental organization called Department of Environment (Adnan, 1991) and the local experts of different fields.

To date, the DFPP has imparted more and in some cases irreversible negative effects compared to its positive effects. Even, the main objective behind the construction of DFPP (to protect the capital city of the nation from perpetual floods and thereby achieve a sustainable economic and environmental development) is still questionable. As (i) the capital city did not face any severe flood after 1988, (ii) the construction materials used for DFPP were not of standard quality, (iii) the design and construction work was not done by qualified professionals and (iv) in many cases even the actual plan was not implemented in practice; it can not be ensured that DFPP is effective enough to save Dhaka City from flood unless it can do so in reality. In the future if it can

protect flood, then warm congratulations to luck! But, if it can not do so, what would happen to the lives of 8 million people (approximately, in 1995) of the city who will not take any preventive measures from flood as the DFPP is providing hope of flood free life? So, it is essential to take curative measures without spending moment. Planting trees and placing Reinforce Cement Concrete (R.C C.) slabs on the toe of the embankment can be alternative solution for this.

According to the 'Guidelines for Environmental Impact Assessment' for Bangladesh Flood Action Plan, 1992

The over all aim of the participation process is to ensure that those social groups affected by a program have an opportunity to decide whether the program should be implemented. People's participation should be developed as "bottom-up" planning process in which local people are fully involved in shaping their own future, rather than being objects in a "top down" planning approach

But, it is a painful lesson learned from this research that people's participation was fully overlooked in this project. Local people had no voice regarding the construction of the embankment contrary to publications by the then government that the project was being made for the people. But, how it is possible to achieve a sustainable environment by implementing a project where the people's perception and participation is absolutely absent? *This double role of the then government has virtually made the whole project a farce.*

Lastly, it can be learned from the effects of DFPP that any large project should not be initiated by the decision of some influential people, bureaucrats or politicians for their own interest, rather should be taken in hand after the consensus of the *bona fide* elected members of the parliament. Obviously, proper Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) must be conducted before implementing any development project. Otherwise, instead of serving expected benefits, the project would impart unacceptable adverse effects which in long run can be shaped as irreversible impacts on the environment and society. Besides this, it can be concluded from the present status of DFPP that *though it has many negative effects, these can be followed by the positive effects in the future by proper planning, implementation and management in all related projects of DFPP.*

#### END NOTES

The sample size was calculated based on approximately 300 (discussion with the respondents during reconnaissance survey) households in six areas and using the following formula:

$$n = \frac{N z^2 p q}{N d^2 + z^2 p q}$$

where:

- n = Number of sample size
- N = Number of population
- z = Level of significance
- p = Proportion of satisfaction
- q = 1-p
- d = Degree of desired precision

In this study, the researcher used 90 per cent confidence level and d=6 per cent. Previous study shows that 227 households out of 1040 had lost their lands due to the construction of DFPP (Azam, 1990) which makes the value of p = 0.218 and q = 0.782. Using above mentioned data the number of sample size (n) becomes 90.

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