CHAPTER 10 PROJECT EVALUATION

10.1 General

10.1.1 Contents of Evaluation

Project evaluation is indispensable when evaluating overall feasibility of the proposed plan. In this Study, the evaluation was conducted covering three aspects: (i) economic impact, (ii) social impact and (iii) environmental impact.

The economic evaluation was undertaken from the economic viewpoint, assessing project viability based on comparison of economic costs and benefits. In this evaluation, the estimation of the benefits was a crucial matter. As no methodologies have previously been established for FFWS projects, a conventional method on the basis of an interview survey was adopted for this Study.

The social impact evaluation was based on a wider perspective than that associated with the economic evaluation. Factors evaluated include social activities affected by the project. This evaluation was necessarily conducted qualitatively because the majority of impacts are intangible.

The environmental impact evaluation was the final and decisive evaluation. Even if the project is considered viable from the economic and social viewpoints, it is unlikely it would be implemented if the environmental impact evaluation were to conclude the project was not environmentally acceptable.

10.1.2 Financial Evaluation and Affordability Evaluation

The financial evaluation to judge financial viability of a project is usually conducted if it will generate financial revenue. In the case of the FFWS, no financial revenue will result from its implementation as the beneficiaries of the project will not pay for the service provided through the improved systems. Therefore, such a financial evaluation was not undertaken in this Study.

Financial affordability is other aspect of financial evaluation. It depends on the scale of operating and maintenance cost associated with the project, the development policy of the GOB, the scale of the BWDB's budget, the priority or degree of urgency of policy or project as judged by the GOB, and so on. The Study Team was not able to obtain data and information to evaluate the financial affordability of this project. As a result, the evaluation of the financial affordability of the project was not executed in this Study.

10.2 Economic Evaluation

10.2.1 Preconditions of Economic Evaluation

(1) Project Life

The project life of this project was adopted as eleven years including one year for implementation. This assumed a 10 year economic life for telemeter stations.

(2) Conditions of Economic Development

The economic benefits usually take into account future socio-economic development plans including the population, land use, products by industrial sector and so on. For this study the economic evaluation of this project was conducted on the basis of the present conditions of economic development.

(3) Project Costs for Evaluation

The proposed project will be implemented by utilizing the existing equipment and facilities of FFWS. The project costs also included existing assets for equipment and facilities and their maintenance cost.

Furthermore, the FFWS will mitigate flood damage by evacuation not only through flood warning but also with supporting works such as well-organized dissemination and response systems including relief and rescue works by the NGOs and other regional inhabitants. The supporting costs are included in the project costs.

(4) Opportunity Cost of Capital

The opportunity cost of capital (OCC) is the cut-off ratio of EIRR to judge the viability of the project. In Bangladesh, the OCC is assumed to be 15% for water resources development projects. However, for disaster management development projects such as flood warning, the OCC is assumed to be lower than 15%. This is because tangible benefits of this kind of project would be less than those associated with other types of water resources development projects but the intangible benefits are assumed to be relatively greater. For this project the OCC was assumed to be 12%.

10.2.2 Economic Benefits

(1) Classification of Avoidable Damage

The benefit of this project is considered to be the avoidable flood damage resulting from the implementation of the improved FFWS. The reductions in flood damage can be classified into that associated with (i) structural measures such as embankments and (ii) evacuation or protective measures for infrastructure after receiving the flood warnings from the FFWS. Basically the flood damage of movables assets could be avoided (or minimized) but infrastructure damage could not be reduced. However, if suitable protective measures could be implemented, the cost for rehabilitation or maintenance would also be reduced.

The following table shows the classification of flood damage avoided through implementation of the two measures.

Classification of Avoidable Flood Damage

Kinds of Flood Damage	Avoidable Damage by Structural Measures	Avoidable Damage by FFWS
1. Damage to Assets	-	-
(1) Buildings	-	-
a. Structure	O	Negligible
b. Indoor Movables	O	O
(2) Agricultural Products	-	-
a. Crops	O	O
b. Livestock	O	O
c. Fishery	O	O
(3) Infrastructure	-	-
a. River Infrastructure	O	O
b. Road	O	Negligible
c. Telecommunication	O	Negligible
2. Damage to Human Life	-	-
(1) Injuries	O	O
(2) Death	O	O
3. Other Damage	O	O

The avoidable damage associated with the improved FFWS include (i) the potential avoidable damage and (ii) the practically avoidable damage.

(2) Potential Avoidable Damage Due to the Improved FFWS

The potential avoidable damage due to the improved FFWS is, under ideal conditions, assumed to be the maximum avoidable damage. Under these conditions most of the constraints to evacuation from the floodplain after receiving flood warnings are eliminated. Major constraints would include the following:

- Insufficient financial funds to protect infrastructure.
- Insufficient modes of transport such as vehicles, boats and rafts for evacuation.
- Poor condition of roads for evacuation.
- Poorly organized communication network for dissemination of flood warning.
- Poorly established response system for evacuation after receiving the flood warning.
- Insufficient time to evacuate after receiving the flood warning.

But even if most of these are eliminated, there are still constraints including physical conditions. Therefore the potential avoidable damage is not equal to the total damage to be avoided under ideal conditions. The physical conditions include the following:

Avoidable Damage Using Experience of Inhabitants

Flood damage has been avoided not only due to the FFWS but also through experience gained by inhabitants. Such reductions in damage could be excluded from the potential avoidable damage.

Indoor Movables

- Inhabitants in flood prone areas build platforms inside houses on which they put movable property for protection even after receiving flood warnings.

Goods are therefore not moved from houses even after receiving the flood warning.

- When the weather is stormy or heavy rain occurs, it is very difficult for inhabitants to transport movable property from houses.
- The first priority in evacuation is to save families. There is therefore not always sufficient time to remove property.
- Inhabitants do not always vacate homes after receiving flood warnings as security may be viewed as insufficient to protect properties from robbery.

River Infrastructure

- The number of workers to protect river infrastructure is not always sufficient.
- Training of workers to implement protection works for river infrastructure is not always sufficient.

Crops

- Crop damage can occur during flooding. However, if there is sufficient time, mature crops could be harvested and immature crops removed for livestock feed.
- Crops which are protected by dikes only suffer damage when the dikes are overtopped. The height of dikes is limited because the higher dikes can suffer damage more readily if overtopped.
- All mature or immature crops are not removed because there is not always sufficient manpower for harvesting.
- After flood warnings, farmers are too busy removing crops to provide assistance to others.

Fishery

- There is no flood damage in Haor areas as fish are not lost during floods in this region.
- Fish easily flow out of shallow ponds and it is difficult to avoid damage even with a FFWS.

Livestock

- Livestock cannot evacuate if they are located some distance away from the owner.
- Livestock in poor conditions cannot be evacuated.

Human Lives

- Some people do not evacuate even after receiving flood warnings so that they can protect their properties.
- People die due to causes other than floods such as snake bites, electrocution, etc.
- The young or aged, the ill and so on cannot evacuate without assistance.

(3) Practically Avoidable Damage Due to the Improved FFWS

The practically avoidable damage due to the improved FFWS reflects the project

benefits. They exclude those components of the potential avoidable damage mentioned above that cannot be eliminated due to the FFWS.

Practically avoidable damage does, however, include the damage to be avoided by the improved or existing FFWS because the avoidance of damage could be accelerated as a result of synergy effects between the exiting and improved FFWS.

(4) Survey of Residents and Staff of BWDB

According to the result of the "Residents-Household Survey" as a part of the "Survey on Evacuation Condition and Awareness of Flood Victims" conducted by the Study Team during the first field study in Bangladesh, the rate of potential avoidable damage to the total damage by category except for the damage for infrastructure range from 50 % to 99 % as shown in the following table. The population (the total respondents in the survey was 305 persons.

On the other hand, the Study Team conducted the interview survey with regard to two categories of avoidable damage mentioned above to the staffs of BWDB. They are 29 staffs of BWDB in total from Divisional O&M Offices (23 persons), Ground Water Hydrology Department (2 persons) and Mapping Center (2 persons) and others (2 persons) of BWDB. The questions for the potential and practically avoidable damage were answered by percentage of them to the total flood damage. The result of the interview survey in the average shows that the rate of potential avoidable damage to the total damage by category except the damage for infrastructure vary from 50% to 88%. The average of interview survey result is shown in **Table 10.2.1**.

It is obvious that the avoidable damage of the residents-household survey are considered to be the potential avoidable damage and have mostly similar characters to the potential avoidable damage of interview survey. Then it could be judged that the household survey on residents is reliable as the information with regard to the potential avoidable damage except infrastructure.

Comparison of Potential Avoidable Damage

Damaged Items	Household Survey Result				Interview Survey Result (Average) (%)	Basic Rate Set Up in This Study (%)
	Total Damage (Taka)	Anticipated Damage in Ideal Situation (Taka)	Avoidable Damage: Net Impact (Taka)	Rate to the Total Damage (%)		
	A	B	C=A-B	D=(C/A) x 100		
No. of Injuries	224,080	13,980	210,100	93.8	88.2	90.0
Movable Properties	609,440	19,260	590,180	96.8	83.0	90.0
Standing Crops	726,800	243,700	483,100	66.5	62.1	50.0
Cattle Lost	726,900	3,900	723,000	99.5	84.3	90.0
Poultry/Duck Lost	194,885	7,110	187,775	96.4	84.3	90.0
Others	1,304,231	620,139	684,092	52.5	52.2	70.0
Total Damage	3,786,336	908,089	2,878,247	80.7	63.7	70.0

Note: 1. Population of the household survey is 305 respondents.
2. The figure of standing crops of basic includes pre-matured crops.

The Study Team also conducted an interview survey with staff of the BWDB with regard to potentially avoidable and practically avoidable damage outlined above. In total 29 staff members of BWDB were interviewed including 23 from Divisional O&M Offices, 2 from Ground Water Hydrology Department, 2 from Mapping Center and 2 others. The questions on potential and practically avoidable damage were expressed as a percentage of the total flood damage. The result of the interview survey indicated that the ratio of potential avoidable damage to the total damage by category (house, agriculture etc.) varied from 50% to 88% apart from damage to infrastructure. The results are outlined in the following table.

Interview Survey Result of Potential / Practically Avoidable Damage by the Improved FFWS (Answer of Minimum Avoidable Damage)

(Unit: %)

Contents of Damage			Potential Avoidable Damage Due to Improved FFWS in Total Damage (A)	Practically Avoidable Damage Due to Improved FFWS by This Project	
				Rate to Potential Avoidable Damage (B)	Rate to Total Damage {(A)/100} x (B)
Houses	Indoor Movables		50.0	90.0	45.0
Agri -culture	Crops		20.0	80.0	16.0
	Livestock		20.0	80.0	16.0
	Fisheries		20.0	70.0	14.0
Infra -structure	Road		4.0	2.0	0.1
	BWDB Projects	Rehabilitation Cost	20.0	20.0	4.0
		Emergency Requirement	20.0	20.0	4.0
Human Lives	Injuries		78.3	70.0	54.8
	Death		80.5	75.0	60.4
Other Damage			41.7	50.0	20.8
Total Damage			39.7	15.0	6.0 *1)

Note *1) is the lump sum value regardless of each category of damage. This differs from the calculated value of 13.3% on the basis of each category of damage.

The avoidable damage of the Residents-Household Survey is considered to reflect the potential avoidable damage and so is equivalent to the potential avoidable damage category obtained in the Interview Survey. This would suggest the results from the Residents-Household Survey are reliable with regard to all potential avoidable damage except infrastructure.

The study team adopted conservative (low) estimates for potential practically avoidable damage based on the minimum percentages obtained from the Interview Survey of BWDB. This was appropriate because economic benefits (that is the practically avoidable damage) were far greater than the project costs. Also understandings and conditions with regard to the potential avoidable damage varied between interviewees, reflecting differences in experiences during flooding, the inherent characteristics of flood types and the forms of evacuation in the areas where they lived. Their responses were generally seen as being rather optimistic.

Based on the estimates for minimum avoidable damage, the potential and practically

avoidable damage was calculated for the 1998 flood. The potential avoidable damage and practically avoidable damage were estimated to be 30,954 million Taka and 20,688 million Taka respectively. Based on these estimates and the total flood damage estimates for 1998 of 115,735 million Taka (see **Section 2.6.3**) the rate of practically avoidable to total damage was estimated as 13.3%.

The practically avoidable damage was estimated for various return periods by applying the 13.3% rate of practically avoidable damage to total damage estimated for each respective return period. The results of the calculations are shown in the following table.

Estimated Probable Practically Avoidable Flood Damage

Return Period (Years)	2	5	10	25	50	100
Flood Affected Area(km^2)	30,000	39,900	49,100	89,500	100,250	103,700
Flood Damage (Million Taka)	6,040	13,136	23,644	51,424	155,735	166,603
Practically Avoidable Flood Damage (Million Taka)	802	1,745	3,141	6,831	20,688	22,131

(5) Average Annual Practically Avoidable Damage by the Improved FFWS

The average annual practically avoidable damage was estimated on the basis of the practically avoidable damage by return period. The result of calculation is shown in the following table. The average annual practically avoidable damage was estimated to be around 1,615 million Taka.

The comparative figures with regard to the total flood damage, the potential avoidable damage, and the practically avoidable damage by category are shown in **Table 10.2.2**.

Average Annual Benefits by the Improved FFWS (Proposed Project) Based on the Practical Avoidable Damage

(Unit: Million Taka in 2002 Prices)

Return Period (Year)	Probability of Occurrence	Flood Damage	Average Damage	Probable Damage	Average Annual Damage
1	----------	0.0			
	(1/1)-(1/2)		401.2	200.6	200.6
2	----------	802.3			
	(1/2)-(1/5)		1,273.7	382.1	582.7
5	----------	1,745.0			
	(1/5)-(1/10)		2,443.0	244.3	827.0
10	----------	3,140.9			
	(1/10)-(1/25)		4,986.0	299.2	1,126.1
25	----------	6,831.1			
	(1/25)-(1/50)		13,759.3	275.2	1,401.3
50	----------	20,687.5			
	(1/50)-(1/100)		21,409.4	214.1	1,615.4
100	----------	22,131.2			

10.2.3 Economic Cost

The project cost in financial prices is usually evaluated at the market prices. These must be converted to economic prices. The basic assumptions applied were as follows.

(1) Basic Assumption

Exclusion of Transfer Items

Transfer items such as tax, interest rate and subsidies by the GOB were excluded from the project cost because these items are not the cost inherent to this project.

Evaluation by the Present Value

The project costs were evaluated at current 2002 prices and inflation was excluded from the project costs until the civil works were terminated. The cost components escalated by inflation were not included in the project cost.

Dividing the Project Cost by Currency Portion

The project costs were divided into local currency portion and foreign currency portion due to the different conversion factors applied to each. The local currency portion includes the costs of materials and labor. It is assumed that the foreign currency portion reflects the international market as the economic cost. A conversion factor for the foreign currency portion is therefore not applicable.

Standard Conversion Factor (SCF)

The standard conversion factor (SCF) is applied to the materials cost of the local currency portion to adjust to the international market price. Because the material cost in the local currency portion is distorted by incomplete competitive markets and by including the tax and so on, it is necessary that it be evaluated using the international market price which reflects the competitive market price. An SCF of 0.926 was adopted for the material cost of the local currency portion of this project.

Shadow Wage Rate (SWR)

Labor is classified into skilled labor and unskilled labor. The cost of skilled labor is assumed to reflect the competitive market price. But the cost of unskilled labor is distorted by the incomplete competitive market due to a bias in information on wage rates, distribution of labor, unemployment and so on.

The shadow wage rate for labor cost was therefore applied to the unskilled labor cost. The shadow wage rate of unskilled labor for water management projects in Bangladesh was adopted as 0.85. This SWR was applied to the unskilled labor cost of the project.

CIF Price

The foreign currency portion was evaluated using the border price of equipment to be imported. The CIF prices were then applied to these.

Existing Assets of the FFWS

The assets of the current FFWS include equipment and facilities, buildings and land. All assets of book value except land were reduced to their depreciated values. The land was evaluated based on the present market price. The assets of existing telemeters will be abolished after implementation of the proposed project. The

existing telemeters were therefore excluded in the economic evaluation of existing assets. The existing assets in financial and economic prices are presented in **Tables 10.2.3** and **10.2.4**.

Operation and Maintenance Cost

The operation and maintenance cost was estimated on the basis of the existing assets and investment cost of the proposed project.

Supporting Cost for the Improved FFWS

The FFWS could not effectively realize its roles and functions by only generating information for flood warning. It is indispensable for the FFWS to be supported by an effective dissemination organization, a response system for evacuation that is closely related to other authorities of the GOB and the private sectors such as NGOs, other grass roots activities and help from other countries and institutions to minimize damage and mitigate impacts on the general public.

Therefore it is necessary to also include the supporting costs as a project cost. The following items were included as supporting costs.

[Dissemination Cost]

The dissemination costs included labor and telecommunication costs to disseminate the warning information to the public as the beneficiaries of the FFWS. The electricity and telecommunication costs to be expended by BWDB were included in the O&M cost of this project. Other dissemination costs were associated with the public mass media such as radio, television and communication among NGOs' unit offices, the Union and Villages.

[Evacuation Cost]

The most urgent needs during flooding are associated with evacuation of people from their homes. Costs are associated with foodstuffs and transport.

[After Evacuation Cost]

After evacuation, people have no choice but to stay for indefinite periods at the shelters or on higher and safer places such roads and hills. They also need foodstuffs, cloths, medicine, fuel and so on.

[Cost for Protection Woks for River Infrastructure]

This includes works to protect the river infrastructure from erosion and collapse. These are indispensable to minimize damage to river infrastructure and reduce its O&M costs.

[Cost for Relief and Rescue Works]

The relief and rescue works are necessary not only during evacuation but also after evacuation. These works formulate the core parts during and after evacuation.

[Cost for Sanitation]

The longer the people remain at shelters or other safe places, the worse the sanitary situation will become. In particular, contamination of water would seriously affect health conditions of the refugees and require provision of additional sanitary equipment and medical treatment.

These supporting costs were roughly estimated on the basis of the flood damage in 1998 (assumed as the 50 year of return period damage). The supporting costs for other return periods were estimated on the assumption that they are proportionate with the practically avoidable flood damage as shown in the table mentioned above. The average annual supporting costs are estimated as 1,194 million Taka as shown in **Table 10.2.7**.

(2) Economic Cost

The economic costs were derived by applying the above conversion factors to the project cost at the financial prices. The financial, economic and operating and maintenance costs are presented in **Tables 10.2.8** and **10.2.9**. The total economic cost of this project is estimated as 1,122.3 million Taka. The local currency portion is 184.1 million Taka and the foreign currency portion 938.1 million Taka.

10.2.4 Economic Evaluation

The economic evaluation was conducted with regard to EIRR (Economic Internal Rate of Return), NPV (Net Present Value) and B/C (Benefit Cost ratio) by comparing cash flow of the economic benefits and costs during the project life as shown in **Table 10.2.10**. The discount rate of 12% was applied to the calculation of NPV and B/C. The EIRR is estimated to be 26.4%, significantly higher than the 12% opportunity cost of capital. Hence this project could be judged as satisfactorily viable.

Result of Economic Evaluation

EIRR(%)	26.4
NPV (million Taka)	708
B/C	1.1

A sensitivity analysis was undertaken to clarify the stability and credibility of this project particularly as economic conditions such as life style of the people of Bangladesh and quality of materials and technology development will vary during the project life.

This involved varying the levels of benefits and costs by ±10%. The results indicated with a 10% increase in benefits and 10% reduction in costs the EIRR will increase to 58.1% (best case scenario). With a reduction in benefits of 10% and increase in costs of 10% the EIRR reduces to -10.7 %. EIRRs for other cases are generally better than the adopted 12% opportunity cost of capital (cut-off ratio of EIRR as the criteria of viability of the project). The results are outlined below.

Result of Sensitivity Analysis for EIRR

(Unit: %)

Benefit \ Cost	-10	- 5	± 0	+ 5	+ 10
-10	26.4	18.0	9.5	0.5	-10.7
- 5	34.7	26.4	18.4	10.4	2.0
± 0	42.7	34.3	26.4	18.8	11.3
+ 5	50.5	41.9	33.9	26.4	19.2
+10	58.1	49.3	41.1	33.6	26.4

10.2.5 Conclusion

As already mentioned, the avoidable damage were based on the results of an Interview Survey of BWDB staff and adoption of conservatively low rates for assessing potential and practically avoidable damage. Taking this into consideration, it is concluded that this project is highly viable. The sensitivity analysis undertaken involving changing project benefits and costs also indicated it has high stability and credibility for the majority of cases assessed.

10.3 Social Impact Evaluation

10.3.1 General Impact

(1) Avoidance of Social Confusion

The avoidance of social confusion is the most direct social impact on the flooded community. The greater the lead time, the longer the time available for people to evacuate and maintain mental and physical well-being. This will minimize social confusion bringing about significant positive impact to the community. The people can avoid mental and physical situations of panic. Also traffic congestion will be mitigated with people having sufficient time to arrange basic facilities such as food and means of transport for safe passage in advance and at an acceptable pace. This will minimize traffic accidents. Overall, the avoidance of social confusion will contribute indirectly to avoid social disorder such as violence and robbery.

(2) Rescue of the Social Weak

If there is sufficient time to evacuate, the possibility of rescuing the socially weak such as babies, the aged, the physically handicapped and the ill will improve. This will prevent the likelihood of health conditions associated with these people deteriorating.

(3) Strengthening of Social Solidarity

The necessity and importance of the dissemination and response systems will be recognized by the individual communities as indispensable for extracting the roles and functions of the FFWS. Solidarity among people in the community will be improved, increasing cooperation and providing more effective communication particularly regarding information on flood warning, safe evacuation procedures, and so on.

(4) Recovery of Socio-Economic Activities

After an evacuation, not only economic activities but also social activities such as education, medical treatment in hospitals, cultural activities, administrative works by the Government and so on are suspended temporarily. If the evacuation can be implemented far earlier, people can prepare to recover these temporally suspended social activities when normal conditions resume. As a result, negative impacts on these social activities could be minimized.

(5) Deepening of Understanding the FFWS

As long as the dissemination and response system work effectively through close communication between the staff of BWDB and the people as the beneficiaries of the FFWS, the people's understanding of information from the flood warning will be deepened and effective evacuation will be accelerated.

10.3.2 Impact for Flood Warning

The "Residents-Household Survey", conducted as a part of the "Survey on Evacuation Condition and Awareness of Flood Victims" during the project, was undertaken with 305 respondents at 15 locations in five regions at Dhaka, Rajshahi, Rangpur, Sylhet and Barisal. The following impacts summarise the results of the survey regarding indirect and direct social impact evaluation in relation to the FFWS.

(1) Receiving Flood Warning and Flood Warning Sources

In the survey, the two words 'flood warning' and 'flood status information/forecast' were considered as synonymous. Even awareness of the respondents through personal observation of flood situations and also information about floods obtained through personal communication from different sources including neighbors, villagers etc. were considered as warnings.

The results showed about 84 to 92% of respondents received flood warning (actually general flood situation information but not 'Warning' in the true sense of the word) in the different flood years of 1987, 1988, 1998 and 2000. It is important to note that the highest percentage of respondents mentioned the sources of flood 'warning' (or general flood information) as TV/Radio, personal observation and contact with neighbors, villagers and relatives. This implies that specific 'warning' was received by very few respondents from district, Upazilla or union level disaster management committees and NGOs. An organized effort in transmitting flood warning by these local organizations would result in less flood damage to the affected people as well as to the nation.

(2) Time of Receiving the Flood Warning Information

Timely receiving of advanced flood warning is a very important factor to the affected people in preparing for their evacuation and other activities to reduce flood damage.

Information on the time of receiving flood warning information by the respondents in different years showed from 24 to 37% of respondents received flood warning information in different flood years at least one week prior to their occurring, 17 to 20% at least 3 days prior, 13 to 28% at least 24 hours prior, 5 to 10% at least 12 hours prior, and 13 to 24 % within 12 hours of the flood.

(3) Receiving Evacuation Instruction Information and Sources of Instructions Information

No organized and pre-planned 'evacuation' by any responsible Government/NGO agencies is practiced throughout the country. Rather, people take shelter on their own in different temporary shelters, such as schools, raised areas, embankments etc. The results showed 64 to 71% of respondents received some form of evacuation instruction. Regarding its sources, 57 to 68% stated TV/Radio, only 2 to 5% newspapers, 11 to 16% district/Upazilla administration, 16 to 31% Pourashava (Municipality)/Union Parishad (Counsel), 15 to 22% NGO/Voluntary organization, 2 to 5% teachers, imams (religious leaders) or social leaders and a large majority of 66 to 71% from neighbor, relative, villagers etc.

(4) Ways and Means of Receiving Flood Warning/Information

The result showed that 67% of respondents mentioned TV/Radio, 37% Pourashava/Union Parishad, 23% local Red Crescent Society/other NGOs, 15% newspaper, 14% announcement of district/upazilla administration, and 59% from other means including personal observation/contact with neighbors, relatives, villagers etc.

(5) Problems for Not Receiving Flood Warning

Different problems arise when not receiving flood warnings. Among the stated problems, 100% of 61 respondents stated the problems as "Could not shift household goods/furniture" and "Could not arrange food/cooking arrangements", 98% stated they "Could not shift family members" and "Could not arrange pure drinking water", and 95% mentioned they "Could not be prepared for evacuation".

Of these responses, the major problem faced when not receiving flood warnings in sufficient time (53% of respondents) was "Could not arrange food items and cooking arrangement". The second problem (21% of respondents) was "Could not shift household goods/furniture" while 14% of respondents stated "Could not shift family members".

(6) Benefits of Receiving Flood Warning in Advance

In terms of benefits of receiving flood warning in advance, 91% reported the benefit as "Could arrange food/cooking" during the period of inundation, followed by 68% as "Could shift family members", 67% as "Could be prepared for evacuation", and 65% as "Could shift household goods/furniture" etc. It is clear that those aspects considered

indispensable for living are considered to be the benefits of a properly functioning FFWS.

10.3.3 Flood Warning/Evacuation Awareness Campaign

Regarding benefits accrued from observing/ participating in the campaign of flood warning evacuation awareness, 12 of the 14 interviewed stated in the affirmative. Of those 12, 10 respondents stated the benefit as finding a shelter, 8 mentioned the benefit of shifting family members, 7 referred to the arrangement of food/ cooking and 6 mentioned advantages of shifting household goods/ furniture etc.

10.3.4 Impact with Regard to Evacuation

(1) Preparatory Measures Adopted for Coping with Flood

On the question of various preparatory measures adopted by the respondents for coping with flooding after receiving flood warning/ information, 92% arranged food/ cooking, 62% organized shifting of family members, 60% arranged shelter, 53% organized both shifting of household goods/furniture and raising a platform in the house etc.

(2) Factors Considered to Take Decision for Evacuation

When deciding on evacuation, major factors considered by the respondents were high water level (90%), the problem of food/cooking arrangement (86%), living conditions being unsuitable in the house during flood (80%), the problems of sanitation facilities (76%) and communication problems (72%) etc.

(3) Evacuation of the Respondents during Floods in Different Years

The highest ratio of evacuation during floods occurred in 1988 (65%), followed by 1998 (51%), 1987 (28%) and 2000 (26%). These evacuation rates are assumed to depend on the degree of awareness of flood warning and degree of dissemination of flood forecasting for the area where respondents lived.

The major places used for evacuation were houses of neighbors, relatives and other villagers (25%~38%), nearby educational institutions (25~36%), embankments, roads, high places, helipads (15~27%), etc.

(4) Routes of Evacuation and Means of Transportation

The major evacuation routes were waterways (70~80%) followed by roads (20~30%). The railway route was used by very few. As a means of transportation, most evacuees used boats and rafts on the waterways followed by foot/head loads. It was noticeable that evacuators did not use vehicles. This suggests vehicles are of limited use for transport during floods because roads are generally inundated by floodwaters.

(5) Supports Provided to the Respondents during Floods

Supports provided by agencies in different flood years were reported by the respondents. The agencies involved were Government, Semi-government and Local

government agencies, NGOs, private organizations and individuals. Most are involved in relief work with very few in flood warning and evacuation.

(6) Problems Faced by the Respondents during Evacuation as per Priority

Combining the 5 regions, 73% of respondents indicated their problems during evacuation included transport, 71% were financial, 58% were related to obtaining suitable shelter, 57% as damage of household goods and furniture and 14% as insecurity, problems of sanitation, etc.

In terms of priorities, transportation was the most critical problem (24%), followed by financial difficulties (22%).

These answers suggest the majority of those evacuating need to move to other places where they have better and safer conditions.

(7) Reasons of Non Evacuation during Floods

About 67% of respondents reported 'insecurity of properties at houses' as the reason for not evacuating, followed by 'evacuation place was not suitable' (50%), 'lack of nearby evacuation place' (38%), 'could not evacuate at short time' (20%), 'did not trust the warning' (16%) and 'did not receive any warning' (12%).

These answers suggest very important problems for the existing FFWS because if earlier, accurate and reliable flood warning could be given to the respondents, they could have evacuated with property in advance of the flood regardless of insecurity. There were some cases under the existing FFWS when immediate evacuation after flood warning did not occur because of unreliability of the flood warning. It was subsequently too late to evacuate with property when flooding actually occurred.

(8) Evacuation of Livestock Animals in Different Flood Years

Some 25% to 46% of respondents evacuated their livestock. Of these, 31% to 45% moved animals to embankments, roads, high places, helipads etc, 20% to 28% to houses of neighbors, relatives/villagers, and 20% to 25% to educational institutions. The locations to which livestock were shifted were marginally different to the locations for evacuation of inhabitants (as discussed in (3)).

10.3.5 Life Condition during Flood

The respondents were asked about conditions of life during the floods. They stated various problems with 96% indicating difficulties with food, 91% isolation/ communication, 88% drinking water and sanitation, 84% sleeping, 74% diseases and damage of property etc. These answers suggest that support of those evacuating by providing food, medical aid, and similar is indispensable to save lives.

10.3.6 Conclusion

From the social viewpoint, it is predicted that this project would bring mostly positive and no negative impacts. It is therefore judged to be socially viable. But as the survey

results show, there are many supporting conditions to ensure flood warnings can achieve their maximum impact. These conditions include the dissemination organization, response system including warning/evacuation awareness campaign, security of the community, supply of food, transport means and routes, financial support, and rescue and relief activities by many governmental and non-governmental groups and agencies.

10.4 Environmental Impact Evaluation

(1) Environmental Impact of Implementation of Proposed Project

The implementation of this project would be carried out by providing equipment in the offices of the flood forecasting and warning services for data processing, in the field for gauging the water level and rainfall, data transmission and so on. Therefore, serious environmental problems often associated with engineering projects such as contamination of water and negative impacts on the ecosystem will not occur.

(2) Protection of River Ecological Environment

If the flood warning is disseminated to the area to be flooded and there is sufficient time to protect the river structures by measures such as piling of sand bags on embankments, the latter could be protected against destruction. As a result, the river water will not flow over the embankment and the natural resources living in river water such as fish, larvae of insects, water micro-organisms and so on will be protected.

(3) Protection of Transport Environment

If the flood warning is effectively conducted and the lead time to evacuate is sufficient, traffic congestion could be minimized, fuel consumption could be reduced and traffic noise minimized. This project will contribute to a limited extent to mitigating traffic congestion and preventing air pollution and traffic noise.

(4) Protection of Water Contamination

The collapse of an embankment would result in overbank discharge and the remote possibility of the overflow mixing with contaminated water such as sewerage. If the river embankment is protected by measures after issuing flood warnings, such water contamination could be mitigated and contribute to preventing any deteriorating of people's health due to contamination.

(5) Conclusion

According to the brief study mentioned above, this project would bring mostly positive effects to the environment and no significant negative environmental impacts. It is therefore judged to be environmentally viable.

Overall, it is concluded that this project is judged to be comprehensively viable based on an integrated evaluation considering the economic, social and environmental viewpoints.

CHAPTER 11 IMPLEMENTATION PROGRAM

11.1 General

The proposed project covers the entire area of Bangladesh and should be implemented as soon as possible. However, a flood forecasting and warning system cannot be used effectively simply by installing equipment. A number of studies and projects should be undertaken before and during the implementation of this project.

In consideration of the realistic implementation of the project in terms of the financial capability and manpower available in the BWDB, a **pilot project is proposed** prior to implementation of the overall scheme. However, some **priority studies should also be done** in parallel with the pilot project.

11.2 Selection of Pilot Project

11.2.1 General

A pilot project should be implemented in an area where flood disasters occur more frequently and the emergency realization against flood disaster is stronger. For this reason, **NE Regional Operation System (Sylhet) is selected as a pilot project area.** A proposed telemeter system, to be controlled from the central office, will be installed for the other regions.

11.2.2 Features of Pilot Project

Project features are presented below with the data transmission network and data transmission flow shown in **Figures 11.2.1** and **11.2.2**, respectively.

(1) Observation System (for all regions)

Manual Observation System

No change is proposed.

Telemeter System

Water level observation: supersonic (sonar) type sensor/sensing pole (float) type sensor

Rainfall observation: tipping bucket type

(2) Data Transmission System

Manual Observation System

Digital transmission system: mobile communication system (HF data transmission system)

Automatic recording system in computer in control station:

Sylhet Region: automatic recording to regional control station

Other regions: automatic recording to central control station directly

Telemeter System (for all regions)

From gauging stations to regional control station: BWDB VHF Link

From regional station to central control station: BWDB HF Link

(3) Analysis System

All the data from both manual observation and telemeter stations are to be used.

Regional Control System: Sylhet only

Forecasting with regional model

Monitoring with observed data from telemeter system

Central Control System

Forecasting with nationwide model (Supermodel)

(4) Warning Dissemination System

Warning Message Dissemination (Forecast): Sylhet only

From regional control station to O&M office, DC office, Upazilla office: e-mail, fax, telephone with T&T public line

Point-to-Point Direct Data Dissemination (Telemeter only)

From telemeter gauging station to O&M office, Upazilla office: VHF Link

Warning Dissemination at Local Level

From Upazilla/Union to Inhabitant/Shelter: Fax, telephone, bike, speaker and visit

11.3 Priority Study on the Project Component

11.3.1 Criteria for Priority Study

The main problems of the existing FFWS are:

a) Flood forecasting and warning message is not utilized effectively.
b) Operation and Maintenance system is not sufficient.

The main reasons for those problems are:

a) The responsibility of river management is not clarified.
b) Dissemination and response system is not sufficient.
c) BWDB organization is not effective for river management.
d) The basic information for river management is not collected in a usable form such as a database.

To overcome these problems strong willingness to seek solutions is essential. In addition, an implementation plan incorporating a reorganization plan and coordination

with other donors and sectors will be necessary.

11.3.2 Project Components

(1) Formulation of O&M Plan

An Operation and Maintenance Plan (O&M Plan) for the Improved FFWS should be formulated by BWDB itself. This should be applicable for the actual Operation and Maintenance Work immediately after implementation of the improved FFWS.

(2) Clarification of River Management

A national water code is urgently required to coordinate water sector development planning. The responsibility of river management should be clarified in the code.

(3) Strengthening of Dissemination and Evacuation (Response)

A Comprehensive Disaster Management Program (CDMP) is currently being prepared with UNDP assistance. The components of the project are a) Capacity Building, b) Partnership Development, c) Community Empowerment, d) Research Information Management, and e) Response Management. It is strongly recommended to UNDP and DMB to take up part of the warning dissemination of the FFWS in their CDMP.

(4) Institutional Study

For conducting effective river management utilizing the proposed FFWS, the existing organization of the BWDB should be improved. However, changing an organization's structure is very difficult and sensitive. A step-wise institutional study should be planned. The "Terms of Reference" for this study has been prepared and is attached as **Attachment-1** in this Volume.

i) Regional Organization Plan for Pilot Project

It is proposed that one regional office should be established as a pilot project to demonstrate the efficiency of the regional system. Therefore, before commencing the pilot project, a regional organization plan for the pilot project area should be prepared and initiated. This will also assist the institutional study.

ii) Operating and Monitoring of Pilot Project

After implementation of the Pilot project, monitoring should be undertaken related particularly to operation and maintenance and coordination with other agencies concerned. The institutional study should consider the output from this monitoring for more possible and effective reorganization.

iii) Institutional Study

After considering the institutional study mentioned above and monitoring, a study for regionalization should be done. Within its framework, a study of re-organization of central hydrology will be undertaken for effective operation of

the regional system. Until the end of the institutional study, all other regions may be operated under the centralized system.

(5) Collecting Information on River Management and Identification of Danger Level

i) Collecting Information on River Structures

Information on river structure, such as location, construction year and characteristics, should be collected and ledger sheets for each structure prepared.

ii) Preparation of Operation Manual

An operation and maintenance manual for river management including river structures should be prepared.

iii) Preparation of DEM (Digital Elevation Model)

An updated DEM should be prepared for deriving inundation maps.

iv) Preparation of Flood Hazard Map

On the basis of information such as river structures, O&M manual and DEM, a hazard map should be prepared. This will be utilized for river management including improvement of FFWS and shown to habitants for evacuation.

v) Review/Identification of Danger Level

On the basis of the hazard map and considering livelihoods of local inhabitants and river structures, proper forecasting points should be selected and danger levels for these locations reviewed.

vi) Survey of River Cross-section

The updating of river cross-sections for the regional model should be conducted based on the existing data survey by BWDB.

11.4 Financial Arrangement

Project costs for the pilot scheme were estimated in terms of investment cost and annual O&M cost. These are outlined in the following table and were based on the calculation procedures described in **Section 9.2.1**.

Investment Cost (Unit: Million Taka)

	Item	Foreign	Local	Total
A	Direct Cost for Installation	523.7	130.9	654.6
B	Administration	0.0	6.5	6.5
C	Engineering	91.6	6.5	98.2
D	Training	3.6	0.4	4.0
E	Contingency	33.2	3.1	36.3
F	Price Escalation	2.6	11.5	14.1
Total		**654.7**	**158.9**	**813.7**

Annual O&M cost (Unit: Million Taka)

Items	Cost
A. Staff	20.6
B. Repair, maintenance	17.3
C. Other O&M	13.3
Subtotal	51.2
D. Depreciation	90.8
Total	**142.0**

The detailed information on the annual operation and maintenance cost for the pilot project is given in **Tables 11.4.1** and **11.4.2**.

11.5 Implementation Schedule

11.5.1 Overall Schedule

After completion of the Feasibility Study, it usually takes some time before implementation of a Project. The overall implementation schedule is given in **Table 11.5.1**. This Study is expected to be completed by December, 2003. It will take about a year for the financial arrangements for the Project. The pilot project is expected to commence in early 2005 and operate from early 2007. During and after the installation, engineering support will be essential.

11.5.2 Components of the Pilot Project

(1) Designing and Preparation of Tender Document

The Project will start with detailed design followed by pre-construction activities, which include tender document preparation and bidding assistance. It will take one year for completion of detailed design.

(2) Implementation and Supervision

After design and preparation of tender documents, it is expected to take one year for procurement and construction. During implementation, supervision by the Consultant will be undertaken.

(3) Operation and Monitoring

After implementation of the system, operation will start. For smooth and effective operation of the pilot project, engineering technical support should be provided for two years.

11.5.3 Components of the Priority Study

(1) Formulation of O&M Plan

Formulation of the O&M plan should be completed by the end of 2003.

The O&M plan was submitted by GOB on December 15, 2003, and it is attached as **Attachment-4** in this volume. The comments and observations of the Study Team on

this O&M plan are discussed in **Section 12.3** and **Attachment-5**.

(2) Clarification of River Management

A national water code is now under preparation and must be completed by the end of 2004.

(3) Strengthening of Dissemination and Evacuation

Inclusion of the FFWS in NWMP and CDMP should start immediately after completion of the Feasibility Study.

(4) Institutional Study

For the institutional issues, a number of work items should be implemented in parallel with the FFWS Project. In particular, the institutional study should be started immediately after completion of this Feasibility Study.

A regional organization plan for the pilot project should be completed prior to the completion of its implementation. Setting up of the pilot regional office at Sylhet should start in parallel with the detailed design for the overall FFWS Project so the two can contribute to the regional office setup. It is expected that the regional office should be established at least 6 months prior to completion of the FFWS improvement project (that is by mid-2006). Details are presented in **Table 11.5.1**.

Monitoring of the pilot project should be started immediately after its implementation. The institutional study should take into account the results of the monitoring of the pilot project.

(5) Collecting the Information for River Management

Preparation of an operational manual, ledger book and facilities database should start after completion of the current Feasibility Study. Preparation of an updated DEM is also expected to be completed before the end of the detailed design for improvement of the FFWS. After collecting the necessary information, hazard map preparation and identification of forecasting points and associated danger levels will also be commenced.

11.5.4 Implementing Agencies

(1) Implementing Agencies for each Component

The implementing agency for the pilot project will be the Planning (ADG) of BWDB. However, for the implementation of the priority studies, coordination with other sectors and some donors are necessary. The assumed implementing agencies of the priority studies are outlined in the following table.

Implementing Agencies by Component for the Priority Studies

Priority Study	Implementing Agency	
	Bangladesh side	Foreign side
a. Formulation of O&M Plan	BWDB	
b. Clarification of River Management	Ministry of Water Resources (MOWR)	
c. Strengthening of Dissemination and Response System	MOWR and the Ministry of Disaster Management and Relief (MDMR)	UNDP
d. Institutional Study	BWDB	Foreign donor agency
e. Collection of information on river management and review of danger level		
- Collection of information on river structures - Preparation of operation manual - review/identification of danger level	BWDB	Foreign donor agency
- Preparation of digital elevation model (DEM) - Preparation of flood hazard map	BWDB, Survey of Bangladesh, and LGED	Foreign donor agency
- Survey of river cross-sections	BWDB	

(2) Arrangement of Implementing Agencies

For implementation of the pilot project, hydrology division should provide the necessary coordination. For better coordination, a "**Task force system**" in the BWDB is proposed. Hydrology division and O&M division staff will work together under a task force formed by staff of both divisions.

CHAPTER 12 CONCLUSION AND RECOMMENDATIONS

12.1 Conclusion

12.1.1 Proposed System

Through in-depth study of the present FFWS and its associated problems, the proposed project was formulated taking into consideration possible solutions for the problems as summarized below.

Present Flood Forecasting and Warning System, Problems Encountered and Possible Solutions:

(1) Observation System

a) Manual observation currently adopted has resulted in the acquisition of erroneous data sometimes contributing to low accuracy of flood forecasting.
b) Important gauging sites (boundary condition sites only) are to be replaced by a telemeter system to eliminate human error in recording and data transfer.

(2) Data Transmission System

a) Data transmission from manual observation sites to the FFWC is currently undertaken using SSB HF radio transmission via voice communication. This can be very inconvenient for operation, sometimes resulting in erroneous data transmission.
b) The SSB HF radio transmission system is to be changed to a digital HF transmission system to create an automatic data input system to eliminate manual operation errors.

(3) Analysis System

Flood Analysis:

a) The analysis system has been considerably enhanced through the application of the MIKE 11-based hydraulic approach. However, estimation of boundary conditions for forecasting can be significantly in error, particularly in flash flood areas.
b) Hydrometeorological data from India is needed. For many years, the GOB has tried to obtain such data from India but with only limited success. There are many difficulties yet to be solved and the GOB should try further to acquire additional information from India. Apart from this, the GOB should also utilize data from weather radars operated by BMD.

Warning Message:

a) Warning messages have been based on the real time observation data and results of flood analysis. The problems involved in the warning messages include: i) not well understood by the people, ii) improper danger levels, iii) inaccurate inundation hazard map due to outdated topographic information, iv) inaccurate forecasts, v)

insufficient lead time, and vi) insufficient warning to the river-related structures including those managed by BWDB.

b) For these problems, individual item by item reviews should be undertaken before and during implementation of the proposed project. For this purpose, technical and engineering assistance will be required.

(4) Warning Dissemination System

a) BWDB is mandated to disseminate flood warning messages down to district level. DMB and Local Government are obligated to disseminate flood warning at the local level. However, flood warning messages have not always reached the end beneficiaries, those are the local people, who wish and need to receive them. Furthermore, and most importantly, Divisional Offices of BWDB have not always received flood forecasts although it is essential for emergency operation and maintenance of river structures.

b) Good coordination between Hydrology and O&M Services of BWDB should be secured through a re-organization of BWDB's set-up. A possible solution is to establish regional offices of BWDB or regional offices of Hydrology Services. The former is the best solution although it will take much time to realize. The latter could be adopted as an intermediate measure.

(5) Response System

a) The response system should provide i) confirmation of receipt of warning message and ii) actions to be taken based on the warning message. However, it is not always sure if the messages are received by the end users. As a result, it is not sure if the end user takes necessary actions for evacuation and emergency operation of the river structures.

b) The response system should be implemented by DMB given its mandate. However, the evacuation system has not been fully established and there is an insufficient number of evacuation centers. The Comprehensive Disaster Management Program (CDMP) being undertaken by UNDP should be enhanced with support of BWDB as a member of the existing Disaster Management Committee.

(6) Institutions

a) Operation and maintenance of FFWS is controlled by FFWC in Dhaka. It is unsatisfactory from many aspects including lack of gauge readers, insufficient maintenance of FFWS, no response system established, insufficient budget and manpower. Ultimately this has resulted in sometimes poor data acquisition. More importantly, the FFWS network does not always cover the objective areas suffering flood damage leading to a lack of sureness, accuracy, timeliness and official-ness related to the flood warnings.

b) A Regional Disaster Management system should be established so that the FFWS is utilized more effectively to meet the actual requirement of the end users.

Proposed System:

In view of the current system and its problems being encountered as mentioned above, the following scheme is proposed. It consists of a **Regional Operation System + Manual & Telemeter Combined Observation System** as summarized below.

(1) Regional Operation System

Five regional operation systems and one supervising control station are to be established.

Five Regional Operation Systems

- North-East (NE) Region: Control Station in Sylhet
- North-West (NW) Region: Control Station in Rangpur
- South-East (SE) Region: Control Station in Chittagong
- South-West (SW) Region: Control Station in Barisal
- North-Central (NC) Region: Control Station in Dhaka

One Supervising Control Station

- Supervising Control Station in FFWC, Dhaka

(2) Manual & Telemeter Combined Observation System

Currently 91 water level gauging stations within Bangladesh are incorporated in the analysis of the FFWS. This number is considered appropriate for flood forecasting purposes. However, the hydrological data for selected stations in India should be added for improving the flood forecast analysis.

As mentioned before, the manual observation currently adopted has sometimes resulted in the transfer of erroneous data. Therefore, some gauging stations are proposed to be changed to an automatic telemeter system.

The number of proposed telemeter stations (water level gauges) is limited to the important stations providing boundary conditions for flood analysis. Other gauging stations remain as manual observation stations. The proposed gauging stations are summarised below.

Proposed Gauging Stations

Region	NE	NW	SE	SW	NC	Supervising C.S. / Total
Location	Sylhet	Rangpur	Chitta-gong	Barisal	Dhaka	Dhaka, FHC
W. Level	***18***	***22***	***9***	***17***	***25***	***91***
Manual	11	17	7	12	21	68
Telemeter	7	5	2	5	4	23
Rainfall	***14***	***15***	***11***	***15***	***13***	***68***
Manual	7	10	9	10	9	45
Telemeter	7	5	2	5	4	23
Total	***33***	***37***	***20***	***32***	***38***	***159***

(3) Feasibility Design

The feasibility design has been developed taking the following into consideration.

a) Location of Gauging Stations

River course shifting with heavy erosion and sedimentation are key issues to be considered in deciding the locations of the gauging stations. Gauge sites were selected based on a detailed field reconnaissance at feasibility level. The selected locations included those not significantly affected by river shifting or, as much as possible, where existing river structures (hard points) could be used to fix the gauges.

b) Gauge Type

For water level observations, sensing pole type and/or supersonic type gauges were adopted after considering existing site conditions.

c) Transmission System

An automatic data input system was applied with a digital HF transmission system.

d) Analysis System

The existing Supermodel will be used for nation-wide analysis covering the entire area of Bangladesh. For regional operation, regional models with some modification will be applied.

Additional data acquisition from India will be utilized as much as possible to improve flood forecast accuracy. Weather radar data of BWD will also be utilized in the analysis system.

Upgrading of the flood forecast message will be enhanced with more accurate and more readily understood information.

e) Dissemination System

Under current regulations, BWDB is mandated to disseminate the warning message down to district level. However, the BWDB will act as a member of NDMC to ensure the dissemination of the warning message to the end users. To respond to the requirements of the local people particularly in flash flood areas, a point-to-point dissemination system will be employed.

f) Response System

Coordination among the related agencies is proposed with BWDB staff to be members of NDMC.

12.1.2 Institutional Set-up for Operation of the Proposed System

For effective operation and maintenance of the proposed system, a new organizational set-up is proposed as follows.

(1) Reorganization of Central Hydrology

For more effective operation and maintenance of FFWS and current hydrology services, the following reorganization is proposed.

a) Creation of a Flood Hydrology Circle (FHC), which comprises "Data Collection Division", "Data Transmission Division", and "Forecasting Division", in the Central Office of BWDB
b) Current PFFC (Processing and Flood Forecasting Circle) will be renamed Flood Hydrology Circle.
c) The other three circles will remain as at present.

(2) Regional Set-up

a) Regional offices of Hydrology will be created in five regions.
b) Each regional office of Hydrology will have four circles, namely, FHC, GWHC, SWHC, and RMRC.

(3) Regulation of New Set-up

a) A Central supervising FHC will be established based on the current FFWC. This office will have a mandate for flood forecasting at the national level. The forecast flood levels at the boundaries of the regional models will be informed to the Regional Offices of FHC for use in regional flood forecasting. The Central FHC will also give advice to the Regional FHCs.
b) Regional FHCs will provide flood forecasts based on the data transmitted from the Central FHC and actual weather conditions in each regional area. The Regional FHCs may disseminate these results locally based on it own judgments and in relation to local conditions.

(4) Other Institutional Issues

In addition to the above, the following are proposed in terms of institutional issues with regard to FFWS operation.

a) Appropriate budget allocation to the O&M of FFWS
b) Preparation of ledger sheet of rivers in Bangladesh
c) Preparation of ledger sheets of river structures
d) Promulgation of water/river code for Bangladesh

12.1.3 Project Cost Estimate

The project cost was estimated based on Investment Cost and Annual Operation and Maintenance Cost.

(1) Investment Cost

Project investment cost is estimated at 1,148 million Taka including equipment cost, construction cost of related civil works, government administrative cost, engineering cost for detailed engineering and procurement assistance, staff training cost, contingency, and price escalation.

(2) Annual Operation and Maintenance Cost (O&M Cost)

Annual O&M Cost is estimated at 65.6 million Taka including staff personnel cost, repair and maintenance cost, and other miscellaneous operation and maintenance costs. Other than the annual operation and maintenance cost, annual depreciation cost of 136.8 million Taka should be considered for budgeting for replacement of equipment whenever necessary. In Bangladesh, depreciation cost is usually not included in the annual operation and maintenance cost for most infrastructure projects. It is suggested that annual depreciation cost be considered for all infrastructure projects.

12.1.4 Implementation Plan

(1) Total Project

Project implementation is assumed to take four years, the first year for detailed engineering, second year for procurement and installation, and third and fourth years for operation and monitoring of the system.

During and after completion of the construction works, technical support by Consultants will be essential.

(2) Pilot Project

The Bangladesh Government, however, has a different opinion on the project implementation in terms of the regional operation system as itemized below.

a) Project implementation is to be conducted on a pilot project basis.
b) The first pilot project is for the Sylhet area where more serious flood damage related to flash floods occurs.
c) The other areas for regional operation of the system will be implemented after due experience of the pilot project.
d) The first pilot project will include the FFWS covering the entire country (proposed nation-wide FFWS) as well as the regional operation system for Sylhet Region as follows:
   - A regional operation system will be established for the Sylhet Region consisting of a regional Hydrology in Sylhet.
   - All other regional operation systems will be implemented in the future.
   - At this stage of the development, all proposed observation systems will be constructed, but a regional office of Hydrology will only be established at Sylhet as a pilot project. All other regional FFWSs (except Sylhet) will

therefore be conducted in the Central Office of FHC.

e) In this alternative stage-wise development, the estimated investment cost is 813.7 million Taka. Necessary annual operation and maintenance cost is estimated at 51.2 million Taka.
f) The Pilot Project scheme may be adopted when it is confirmed that its Operation and Maintenance can be properly undertaken. A suitable O&M Plan should be prepared by BWDB.

12.1.5 Project Evaluation

(1) Economic Evaluation

Economic evaluation of the proposed project was conducted based on the evaluation of costs and benefits attributable to the proposed FFWS.

Benefit estimation was rather complicated as there are no standard criteria for its estimation for projects such as an FFWS. Therefore the benefits were estimated by means of an interview survey that is similar to a willingness-to-pay survey. The interview survey was conducted as a social survey for the people affected by flood damage and also for staff of BWDB. The data obtained included estimates of avoidable damage (as a percentage basis) both with and without an FFWS.

The result of the economic evaluation indicated the proposed project has an EIRR of approximately 26%.

(2) Other Evaluations

Given the type of project, it can be said that there is unlikely to be any negative social or environmental impact due to the FFWS. Rather it is likely that the project would contribute positively to social stability.

12.1.6 Recommendation

In conclusion, the project is highly evaluated from economic, social and environmental viewpoints and is technically feasible.

It is noticeable, however, that the project involves a rather sophisticated system and therefore sound operation and maintenance is essential to ensure the systems remain functional.

It is strongly suggested that BWDB consider the following to maximize the effective utilization of the system once implemented.

a) Secure the necessary O&M budget for operation and maintenance works
b) Establish appropriate organizations with well-experienced and capable management and staff for overall supervision of system operation.
c) Establish the following as part of comprehensive river management practice:
   - Promulgate water code or river code
   - Collate ledger sheets of river structures for their operation and maintenance

both generally and in response to flood warnings from the FFWS; such structures are important beneficiaries of the FFWS output

Overall, it is recommended that this proposed project be implemented at the earliest possible time provided the necessary and appropriate O&M work and budgets can be secured.

12.2 Recommendations

12.2.1 Implementation of the Project

(1) Pilot Project

The pilot project is proposed to be established in terms of the regional operation system as itemized below.

a) Project implementation is to be conducted on a pilot project basis.
b) The first pilot project is for the Sylhet area where serious flood damage occurs due to the occurrence of flash floods.
c) The other areas for regional operation systems will be implemented after due experience in the pilot project.
d) The first pilot project will include the FFWS covering the entire area of Bangladesh (nation-wide FFWS) as well as the regional operation system for Sylhet Region as follows:
   - A regional operation system will be established for the Sylhet Region consisting of a regional FFWC in Sylhet.
   - All other regional operation systems will be implemented in the future.
   - At this stage of the development, all proposed observation systems will be constructed, but a regional office of Hydrology will only be established at Sylhet as a pilot project. All other regional FFWSs (except Sylhet) will therefore be conducted in the Central Office of FHC.

(2) Priority Study for Pilot Project

Formulation of O&M Plan

An Operation & Maintenance Plan (O&M Plan) of Improved FFWS should be formulated by BWDB. This should be able to be implemented for the actual Operation and Maintenance Work immediately after implementation of Improvement of FFWS.

Clarification of River Management

A national water code is urgently required to coordinate water sector development planning. The responsibility of river management should be clarified in the code.

Strengthening of Dissemination and Evacuation (Response)

A Comprehensive Disaster Management Program (CDMP) is currently being prepared with UNDP assistance. The components of the project are a) Capacity Building, b) Partnership Development, c) Community Empowerment, d) Research Information

Management, and e) Response Management. It is strongly recommended to UNDP and DMB to take up part of the warning dissemination from the FFWS in their CDMP.

(3) Institutional Study

Regional Organization Plan for Pilot Project

Before implementation of the pilot project, a regional organization plan should be in operation and so should be developed.

Monitoring of Pilot Project

After pilot project implementation, a monitoring study should be undertaken considering operation and maintenance and coordination with agencies concerned. The institutional study should consider the output from this monitoring for further and more effective reorganization.

Institutional Study

In light of the organization plan and monitoring, a study for regionalization will be undertaken. This will included assessing the need for re-organization of central hydrology to promote more effective operation of the regional system.

(4) Collecting Information of River Management and Identification of Danger Level

Collecting the Information for River Structures

The information of river structures, such as location, construction year, and characteristics, should be collected and prepared in the form of ledger sheets.

Preparation of Operation Manual

Operation and maintenance manuals for river management including river structures should be prepared.

Preparation of DEM (Digital Elevation Model)

A DEM should be prepared using updated topographic information for development of hazard maps.

Preparing Flood Hazard Maps

On the basis of the above information on river structures, O&M manual and DEM, hazard (inundation) maps should be developed. These will be utilized for river management including improvement of FFWS and used by local people for evacuation.

Review/Identification of Danger Level

On the basis of inundation maps, people's livelihoods and river structures, proper locations for analysis points should be selected and danger levels defined.

Survey of River Cross-sections

The updating of river cross-sections is important for regional (as well as nation-wide) modeling.

(5) Arrangement of Implementation Agencies

For the implementation of the pilot project, coordination with O&M division will be essential. The main counterpart will be hydrology division of BWDB, but a task force system in the BWDB is necessary for efficient implementation. Hydrology and O&M divisional staff should work together under the same umbrella.

12.2.2 Improvement of Organization

(1) Reorganization of Central Hydrology

Even in the regional setup, reorganization of central Hydrology is required to avoid duplication of responsibility and to provide streamlining of the job functions and better coordination.

(2) Regional Setup

Considering all the above factors along with technical, hydrological, financial, and organizational issues, and maximum utilization of present facilities, it is proposed to create five regions of Hydrology. These are Northwest (NW), North Central (NC), Northeast (NE), Southwest (SW) and Southeast (SE).

Regional office location should consider availability of various logistical facilities and better river management. Based on these, the regional offices are proposed to be established at Dhaka, Chittagong, Barisal, Rangpur and Sylhet.

(3) Institutional Study

Institutional change is very sensitive and requires careful, in-depth planning. It was therefore beyond the scope of the present Study. Hence, it is proposed to undertake a separate institutional reform study for in-depth analysis of the above proposal.

As BWDB is fully aware of the severe constraints of the present system, there is already one proposal put forward by BWDB for institutional study. A draft TAPP was prepared in 2001 with the title "Institutional Strengthening of Hydrological Services in Bangladesh". However, that Study has not yet commenced (end of 2003).

In line with the proposal for a separate institutional reform study, "Terms of Reference" have been prepared and are attached as **Attachment-2** in this Volume.

(4) Pilot Project

It is proposed that at least one regional office should be established as a pilot project to demonstrate the efficiency of the regional system. This will also assist the institutional reform study. The Northeast (NE) region is proposed to be taken up for the pilot study

because of that area's vulnerability to flash flooding. Until the end of the institutional reform study, all other regions will be operated under the centralized system.

(5) Other Institutional Issues

Apart from the two institutional issues, that is the re-organization of Hydrology central office and establishment of Regional Hydrology Offices, a number of other steps should be taken in order to improve the functions of BWDB. These are summarized below.

a. There must be an operational manual for BWDB facilities. In addition, a ledger book must be maintained for each facility.
b. Vacancies in the key technical positions must be filled urgently.
c. A database must be prepared for all BWDB facilities.
d. Incentive mechanisms should be introduced for increasing motivation of BWDB staff.
e. Issues of FFWS must be included in the National Water Management Program.
f. Sub-sector studies should be undertaken to identify specific schemes in the light of NWMP.
g. A nationwide water balance study should be updated periodically.
h. In the up-coming UNDP-financed CDMP, FFWS should be clearly defined.
i. A national land use policy is to be prepared for coordinated development planning.
j. A national water code is urgently required to coordinate water sector development planning.
k. Detail flood damage must be assessed.

12.2.3 Operation and Maintenance Budget

The O&M Budget for the existing FFWS is inadequate. For this reason, the existing telemeter system is not operated and utilized effectively. Therefore, if the Bangladesh Government requires a sophisticated system such as the proposed telemeter system, an increase in the O&M budget will be essential.

The O&M budget is estimated in **Chapter 9**. A summary of O&M cost estimation for the existing system (actual and required) and with the FFWS project is shown below:

Operation and Maintenance Cost

(Million Tk.)

Items	Actual O&M Cost	Required O&M Cost for Existing System	Project O&M Cost
Staff	24.4	24.4	23.0
Repair, Maintenance	1.7	10.5	27.1
Other O&M	8.0	9.4	15.5
Subtotal	***34.1***	***44.3***	***65.6***
Depreciation	0.0	26.3	136.8
Total	**34.1**	**70.6**	**202.4**

(1) Staffing

O&M staff costs with the FFWS project are estimated to reduce by 1.4 million Taka from existing actual O&M costs, reflecting a reduction in staff numbers for the improved system.

(2) Repair and Maintenance

If repair and maintenance expenditure is insufficient, the system will face problems and may not be utilized fully.

If systems and equipment are installed, a sufficient budget must be allocated for repair and maintenance. As a general estimate, repair and maintenance cost equivalent to around 0.5% to 1.0% of equipment cost and 10% of computer cost are necessary.

Repair and maintenance cost for the existing FFWS is 1.7 million Taka but actually 10.5 million Taka is realistically required. For the proposed project this will increase to 27.1 million Taka.

(3) Other O&M

Communication cost including T&T and vehicles is the main cost of 'other O&M'. If this allocation is not sufficient, dissemination will also not be sufficient and the system will not be utilized effectively.

(4) Depreciation Cost

Systems and equipment will definitely have to be replaced in the future. Hence, a depreciation cost is necessary to cover this. In Bangladesh, depreciation cost is not considered for most projects, but if the FFWS is to continue indefinitely thought should be given to including depreciation as a legitimate project cost.

(5) Evaluation of O&M cost

For improved FFWS, a budget of around 65.6 million Taka will be necessary to cover O&M costs. Compared with the present budget of BWDB, this O&M cost is considerably higher and must be arranged.

12.3 Pre-arrangement for Project Implementation

The O&M plan for the proposed project was prepared by the BWDB, approved by the GOB, and submitted to the JICA Study Team on December 15, 2003. This O&M plan is included in this volume as **Attachment-4** as it is. The comments of the Study Team on the Plan are given also in this volume as **Attachment-5** in detail.

The plan covers necessary items for the proper operation and maintenance activities such as necessary manpower, budget, organization, and so on. However, the plan seems to be insufficient and still has rooms to be brushed up especially for the topics of;

- Existing Telemeter System,

- Regional Operation System (Institutional Aspect), and
- Cooperation with O&M Division of BWDB and Other Agencies.

In terms of the institutional/organizational issues, the Study Team fully understands that it is difficult for BWDB to make detached decision, because BWDB is the one which is subject to be changed. And this causes the gaps between the Study Team and BWDB to remain unsolved.

To make the efforts made by BWDB and GOB fruitful, an institutional study should be undertaken before or in conjunction with the implementation of the Project. The Terms of Reference (TOR) of the institutional study is drafted by the Study Team as given as **Attachment-1** of this volume. The proposals issued both by the GOB and the Study Team can be examined in detail and adjusted through this institutional study from much wider viewpoint. Although the Water Management Improvement Plan (WMIP) funded by the World Bank (WB) is undergoing, the study on the organizational reform of BWDB is not within the scope of this WMIP according to the WB.

The GOB may be highly appreciated if it thinks about this recommendation positively and makes official request to the WB or other foreign assistance agencies.

12.4 Necessary Arrangements for Effective FFWS Operation

12.4.1 Water Code or River Code in Bangladesh

A Water Code or River Code for Bangladesh is essential for river management. This should cover all sectors related to river and water, watershed management, water use including water resources development, flood control, water quality management and river environment management.

According to the WARPO, the Government of Bangladesh is now preparing the Water Code or River Code and a Draft has been completed. However, the Study Team was not provided with a copy as it is not yet authorized. It is not known when it will be enacted.

As mentioned in **Chapter 2.8**, the GOB has issued the National Water Policy, National Water Management Plan and other relevant policies bearing on the water sector. These materials may be used as the implementing rules and regulations of the Water Code when it is promulgated. This implies that those policies could be integrated in the National Water Code or River Code. The JICA Study Team recognized that the National Water Code or River Code will be enacted in the near future.

Although the Study Team has no knowledge of the contents of the draft of the Water Code or River Code, it is recommended that the following are clearly stated in the document, in addition to existing regulations from the viewpoint of flood control:

a) Classification of Rivers in terms of responsibilities of the Government on river management, that is either Central or Local Government
(For this purpose, a ledger sheet of rivers should initially be prepared

defining "The Rivers in Bangladesh")

b) River area and land ownership of the river area
c) Utilization of river area
d) Other relevant factors

12.4.2 Issues Regarding International Rivers

As mentioned in **Chapters 3** and **5**, effective flood forecasting and warning in Bangladesh requires acquisition of additional data and information from India and their incorporation into the modeling system of FFWC. In light of the slow progress of the JRC talks with regard to the proposal made by Bangladesh in 1996, it is important for FFWC to take the following actions as soon as possible:

- To collect all data and information transmitted from India through the point-to-point exchange arrangement on a continuous basis;
- To incorporate all data and information sent from India, i.e. those coming through the IMD-BMD arrangement, point-to-point exchange data, rainfall data obtained from the website, and any other relevant information into the modeling system of FFWC; and
- To conduct simulations using the available data from India to determine their usefulness and limitations and present the results to the Bangladesh JRC for further negotiations with the Indian side.

In addition, as advised in **Section 12.3.4** below, the operation rules and records of barrages on key rivers in India should be made available and a trans-boundary water release warning system must be established as an essential measure to mitigate artificial flood damage. MOWR is advised to take initiatives to (re)include these issues in the JRC agenda.

While pursuing further dialogue and negotiations at the government level, supplemental efforts at the non-governmental level would be needed for building trust and understanding between Bangladesh, India and Nepal. "Second track" approaches being undertaken or planned for this purpose can be supported with a particular focus on flood management. Detailed technical level dialogue and exchanges involving government engineers of the three countries (Bangladesh, India and Nepal) to the extent possible in unofficial meetings and forums will help promote an environment for similar exchanges at the government level, as was experienced in the 1990s leading up to the conclusion of the 1996 Ganges Treaty.

In addition to flood management, efforts aiming at long-term, rational solutions looking at the entire river courses need to be pursued to address other issues such as water shortage, water quality, sedimentation, bank erosion, ecology and environment. The attention in Bangladesh in recent years appears to have shifted to the construction of river schemes within the country including the proposed Ganges barrages to augment dry season flows. However, the proposed schemes identified in the draft National Water Management Plan require further, detailed studies. While undertaking further studies on these schemes, negotiations aimed at comprehensive management

frameworks for the GBM Rivers should be promoted.

The first step needed towards such a direction is to conduct an objective study to determine water balance in the GBM, based on which a master plan can be developed. Simultaneously, free and wider sharing of all relevant information and data on the common rivers and projects and interventions thereon needs be promoted. "Second track," non-governmental level dialogue and activities and a skilled and neutral intervention of a third party at the government level would be required to facilitate the process.

In the meantime, BWDB needs to strengthen its domestic river management system as part of its efforts toward international river management. In particular, it is important to consistently monitor, analyze and report on such aspects as water level, discharge, sedimentation, groundwater, water quality, and salinity on key rivers. This will help identify exact problems encountered in international rivers, which will in turn enhance the negotiation capacity and position of Bangladesh vis-à-vis co-riparian countries.

12.4.3 Flood Damage Survey

Flood damage data are indispensable and provide a basic parameter for the estimation of benefits attributable to the FFWS. Unfortunately, there are no comprehensive official flood damage data in the BWDB. A flood damage survey was therefore undertaken during the current study to obtain more detailed and objective data.

The following recommendations are made regarding flood damage information.

(1) Integration of Information on Flood Damage

As already mentioned in **Section 2.6**, many Governmental and non-Governmental agencies are concerned with collecting information on flood damage. The major agencies concerned are FFWC under BWDB, DMB and DRR (Directorate of Relief and Rehabilitation) under MDMR, EMB, Disaster Forum Bangladesh and newspapers. Within each agency there is, however, no systematic collation or integration of flood damage information between them. The urgent tasks to be tackled with regard to flood damage include: (i) a review of the existing system of organization and information in each agency as soon as possible, and (ii) to improve the existing organization and systems of the concerned agencies with the aim of integrating information between them.

(2) Establishment of Information System of Flood Damage

A comprehensive, integrated information system of flood damage is indispensable to accurately record and define flood damage. FFWC (under BWDB) and DMB should be the core agencies of this system. Data on flood damage should be collected systematically from the actual damage areas.

(3) Preparation of Database

Flood damage data should be continuously recorded as a time series of information on a database in the core agencies such as FFWC. The time series are very useful to identify trends in historical flood damage, particularly regarding changes in damage with severity of flooding, and could be utilized for the forecasting of long-term flood damage and appropriate flood disaster management and approaches to mitigation.

(4) Preparation of Manual for Flood Damage Survey

Limited flood damage surveys have been conducted separately by the various agencies. The form of survey and sampling methods should, however, be unified by preparing a manual for flood damage survey.

(5) Implementation of Flood Damage Survey

The following information and studies are necessary to be included in a flood damage survey.

Flood Prone Area by Return Period

Flood prone areas by return period are the basic data for flood damage estimation. As there is no comprehensive and official data in Bangladesh, this is urgently required.

Land Use by Category

Land use data and contour maps by category could be the base for estimation of flood damage by category. There is a detailed agricultural land use map but the existing contour map is based on topographic conditions in 1960. This is outdated and to estimate the actual conditions of land use the contour maps need to be updated.

Category of Damage

It is necessary to classify flood damage into categories such as assets (agriculture, building and infrastructure), human life (injuries and death) and the suspension of socio-economic activities. More detailed categories may also be necessary depending on the type of study being carried out.

Value of Assets

Estimated flood damage is required in money terms and the unit value must be set up by category.

Value of Human Life

The value of human life is basically very difficult to define as it has no market price. However, fatalities are prevented through the FFWS and this must be reflected as a benefit of the FFWS in the same way as other damage categories. Consideration needs to be given to how to estimate this benefit. Some methods have been developed in relation to life insurance for injuries and death by sickness and accident.

Damage Rate by Return Period and by Inundation Depth

The damage rate by return period and by inundation depth is generally set up on the basis of value of assets and damage by category.

12.4.4 Operation and Maintenance Record of River Structures and FFWS

At present there is no ledger sheet of river structures and FFWS. The JICA Study Team was informed that the O&M Circle, Central Office is now preparing a database of the river structures.

The ledger sheets are a prerequisite for operation and maintenance of the river structures. Therefore, it is strongly recommended that they be completed as soon as possible and should include the following items.

- Project Features
- Operation and Maintenance Records
- Damage and Repair Records
- Emergency Protection Works
- Large Scale Rehabilitation Works

The ledger sheets should be updated annually reflecting the activities taken during the previous year. They would then be useful for planning operation and maintenance works in coming years. More effective operation would contribute to cost savings. Reference can be made to a format from the Questionnaire Survey conducted by the Study Team and its results presented in **ANNEX-III**. The format of the ledger sheets can be prepared with some modifications to that format as required.

TABLES

Table 2.2.1 Historical Performance of Population and Gross Domestic Product of Bangladesh by Major Industry Activity (at Current Prices)

(Unit : Million Taka)

Industrial Origin	Sector	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02	Average Annual Growth Rate (%)
Agriculture	Agriculture and Forestry	295,319	261,871	269,000	310,060	324,382	350,462	381,359	429,901	446,923	456,311	473,679	4.8
	Fishing	44,078	55,066	65,823	76,307	85,500	96,415	108,742	124,854	136,738	134,061	137,486	12.0
	Sub-Total	339,397	316,937	334,823	386,367	409,882	446,877	490,101	554,755	583,661	590,372	611,165	6.1
Industry	Mining and Quarrying	10,517	12,707	13,699	15,444	16,691	18,002	19,517	20,664	23,112	26,398	29,254	10.8
	Manufacturing	160,620	179,954	199,792	224,560	246,351	270,605	312,692	327,828	348,371	382,342	412,453	9.9
	Electricity, Gas, and Water Supply	17,922	19,517	21,124	22,685	24,009	25,537	26,433	28,381	30,722	33,464	36,527	7.4
	Constructuin	70,562	75,347	83,198	96,961	109,993	121,695	138,588	156,249	176,218	193,344	210,108	11.5
	Sub-Total	259,621	287,525	317,813	359,650	397,044	435,839	497,230	533,122	578,423	635,548	688,342	10.2
Service	Wholesale and Retail Trade	141,565	149,874	163,588	188,727	206,076	220,374	248,444	272,319	292,037	324,789	355,274	9.6
	Hotel and Restaurant	6,835	7,300	8,045	8,841	9,782	10,328	11,561	13,165	14,628	15,902	17,295	9.7
	Transport, Stoarage and Communication	112,156	119,477	126,826	135,252	144,831	155,841	167,413	180,413	197,434	221,286	241,410	8.0
	Financial Intermediation	16,389	18,034	20,064	22,464	25,171	27,595	29,918	33,551	36,475	39,106	41,891	9.8
	Retail Estate, Renting and Business Service	98,844	108,562	119,956	130,952	151,036	162,952	176,285	195,837	211,391	223,653	239,947	9.3
	Public Administation and Defense	25,903	31,063	33,810	36,872	40,165	44,188	49,604	55,523	62,340	66,952	72,293	10.8
	Education	22,888	25,708	28,241	30,729	33,042	36,099	41,366	47,178	53,859	58,518	63,483	10.7
	Health and Social Service	26,587	29,258	31,543	33,798	36,388	39,424	43,709	48,416	53,762	57,221	60,614	8.6
	Community, Social and Personal Service	104,824	113,570	121,739	130,728	142,943	153,812	170,285	184,971	203,596	216,645	230,484	8.2
	Sub-Total	555,991	602,846	653,812	718,363	789,434	850,613	938,585	1,031,373	1,125,522	1,224,072	1,322,691	9.1
Total		1,155,009	1,207,308	1,306,448	1,464,380	1,596,360	1,733,329	1,925,916	2,119,250	2,287,606	2,449,992	2,622,198	8.5
Population(in Million)		106.3	107.9	109.5	111.1	112.8	114.4	116.1	117.9	119.6	121.4	123.2	1.5
Population Density (person/km^2)		723	734	745	756	767	778	790	802	814	826	838	1.5
Per Capita GDP		10,866	11,191	11,933	13,179	14,157	15,146	16,583	17,980	19,124	20,182	21,284	7.0

Source : Statistical Yearbook of Bangladesh, 2000, Bangladesh Bureau of Statistics (BBS)

Note : The figure of 2000/01 is preliminary.

Table 2.2.2 Socio-Economic Condition by District (Zilla)

Name of Division	Name of Zilla (District)	Total Area (ha)	Population (person)	Population Density (Person/km²)	No. of Households	Major Agricultural Crops (ha)			Livestock			Fish Pond
						Paddy	Wheat	Jute	Cattle & Baffalo	Goat & Sheep	Fowls & Ducks	
						Total Area (ha)	Total Area (ha)	Total Area (ha)	Total Heads	Total Heads	Total Heads	Total Area (ha)
Barishal	Barguna	183,200	837,955	457	179,189	103,920	40	127	285,605	91,225	1,785,445	2,326
	Barisal	279,000	2,330,960	835	474,840	158,137	3,148	3,938	413,983	163,293	3,176,714	3,897
	Bhola	340,300	1,676,600	493	328,559	150,231	6,572	227	265,335	166,920	3,071,880	4,444
	Jhalokhati	75,800	696,055	918	145,868	55,106	32	247	152,032	46,022	1,074,881	1,211
	Patuakhali	320,500	1,444,340	451	288,605	175,736	117	227	432,993	158,121	3,132,246	1,277
	Pirozpur	130,800	1,126,525	861	231,983	97,328	57	425	256,122	77,832	1,852,116	2,217
	Subtotal- A	*1,329,600*	*8,112,435*	*610*	*1,649,044*	*740,458*	*9,967*	*5,191*	*1,806,070*	*703,413*	*14,093,282*	*15,372*
Chittagong	Bandarban	448,000	292,900	65	59,345	28,201	4	84	92,085	50,550	461,140	0
	Brahmanbaria	192,700	2,365,880	1,228	432,380	122,768	12,729	7,488	384,811	162,675	2,806,249	3,849
	Chandpur	170,400	2,210,162	1,297	422,697	101,042	10,411	4,927	283,157	150,723	2,752,844	3,396
	Chittagong	528,500	6,545,078	1,238	1,234,682	216,297	178	160	651,867	249,720	3,774,711	10,003
	Comilla	308,400	4,586,879	1,487	831,033	289,835	27,459	7,857	729,294	435,993	5,757,881	6,302
	Cox's Bazar	249,200	1,757,321	705	294,094	83,747	15	15	261,660	116,655	2,109,280	4,302
	Feni	92,800	1,196,219	1,289	213,030	79,374	256	14	179,988	68,200	1,835,466	2,019
	Khagrachari	269,900	524,961	195	109,718	31,642	27	27	119,347	81,259	640,702	0
	Lakshmipur	145,600	1,479,371	1,016	288,214	101,180	2,482	626	192,358	102,687	2,213,052	2,918
	Noakhali	360,100	2,533,394	704	455,321	180,610	240	626	327,699	185,929	3,873,537	6,270
	Rangamati	611,600	507,180	83	103,974	35,416	48	375	110,000	86,655	692,225	0
	Subtotal- B	*3,377,200*	*23,999,345*	*711*	*4,444,488*	*1,270,112*	*53,849*	*22,199*	*5,332,266*	*1,691,046*	*26,917,087*	*39,059*
Dhaka	Dhaka	146,400	8,575,533	5,858	1,788,281	30,878	4,872	4,677	142,203	61,317	684,650	1,349
	Faridpur	207,200	1,719,496	830	345,357	93,926	23,636	30,564	320,355	225,493	1,521,007	1,913
	Gazipur	174,100	2,026,244	1,164	443,307	78,254	1,214	4,449	309,291	228,155	1,302,696	1,674
	Gaopalganj	149,000	1,132,046	760	217,445	107,524	4,474	7,713	210,812	75,981	936,773	1,013
	Jamalpur	203,200	2,089,366	1,028	481,152	156,653	18,176	20,613	421,270	244,520	2,010,675	1,364
	Kishoreganj	268,900	2,525,221	939	528,323	190,129	9,493	12,539	455,354	222,600	2,536,204	871
	Madaripur	114,500	1,137,008	993	232,111	69,453	8,557	15,619	199,685	137,749	1,304,380	2,332
	Manikganj	137,800	1,274,829	925	276,661	73,501	9,827	5,774	256,175	166,218	1,015,843	1,023
	Munshiganj	95,500	1,293,536	1,354	251,280	32,901	2,758	8,568	166,107	62,625	1,008,252	1,259
	Mymensingh	436,200	4,439,017	1,018	965,123	465,971	18,323	22,233	940,596	669,412	4,655,154	907
	Narayanganj	75,900	2,138,492	2,818	444,326	28,341	2,611	2,479	94,802	109,529	856,191	3,658
	Narsingdi	114,100	1,891,281	1,658	387,681	81,838	4,312	8,631	288,418	250,141	1,962,460	650
	Netrokona	281,000	1,937,794	690	406,153	247,534	4,572	11,958	446,791	210,131	2,201,217	1,025
	Rajbari	111,900	940,360	840	189,427	58,064	12,570	14,102	190,171	142,454	773,847	2,852
	Shariatpur	118,200	1,057,181	894	213,239	79,028	11,498	10,712	175,303	114,151	1,474,659	1,009
	Sherpur	136,400	1,246,511	914	296,535	141,887	5,407	4,830	264,460	165,425	1,216,955	564
	Tangail	341,400	3,253,961	953	726,561	220,381	16,760	19,817	708,292	467,625	3,459,217	1,459
	Subtotal- C	*3,111,700*	*38,677,876*	*1,243*	*8,192,962*	*2,156,265*	*159,060*	*205,279*	*5,590,085*	*3,553,526*	*28,920,180*	*24,922*
Khulna	Bagerhat	396,000	1,515,815	383	321,634	118,106	222	595	283,460	134,196	1,734,134	1,280
	Chuadanga	115,800	987,382	852	223,233	56,164	18,444	13,998	178,855	230,501	1,156,337	517
	Jessore	256,700	2,440,693	951	521,360	187,262	15,160	21,635	609,042	542,018	3,380,795	2,822
	Jhenaidah	196,100	1,554,514	793	331,601	135,304	16,320	17,796	398,831	301,130	1,959,940	2,134
	Khulna	439,400	2,334,285	531	494,603	112,140	299	1,622	314,078	165,337	1,362,006	2,651
	Kushtia	162,000	1,713,224	1,058	375,444	80,994	20,373	14,679	317,750	275,730	1,443,765	699
	Magura	104,900	811,160	773	161,474	72,165	8,051	14,219	212,434	132,500	787,559	1,128
	Mererpur	71,600	579,531	809	135,908	34,692	14,332	13,702	105,501	164,791	732,007	317
	Naril	99,000	689,021	696	140,013	62,400	4,393	8,200	164,727	78,046	635,278	1,071
	Satkhira	385,800	1,843,194	478	390,179	125,630	3,473	7,485	428,328	352,690	2,119,214	1,457
	Subtotal- D	*2,227,300*	*14,468,819*	*650*	*3,095,449*	*984,858*	*101,067*	*113,932*	*3,013,006*	*2,376,939*	*15,311,035*	*14,076*
Rajshahi	Bogra	292,000	2,988,567	1,023	687,287	289,924	9,647	12,664	685,528	465,537	4,076,676	4,268
	Dinajpur	343,900	2,617,942	761	576,403	330,858	41,182	10,487	826,610	641,411	3,857,992	5,036
	Gaibandha	217,900	2,117,959	972	493,101	182,074	18,027	15,323	487,979	398,263	2,637,767	884
	Joypurhat	96,500	844,814	875	203,255	110,552	4,155	2,282	239,966	204,541	1,581,649	1,410
	Kurigram	229,600	1,782,277	776	397,021	145,861	22,443	24,090	427,020	310,165	2,117,310	931
	Lalmonirhat	124,200	1,088,918	877	241,713	90,330	10,615	10,360	280,085	244,000	966,620	494
	Naogaon	343,500	2,377,314	692	539,833	313,153	16,741	4,676	687,805	578,112	3,499,403	5,416
	Naotore	189,500	1,521,359	803	337,476	123,057	17,717	6,359	279,829	263,560	1,652,948	2,915
	Nawabganj	170,200	1,419,536	834	275,122	95,469	13,249	1,030	249,652	263,223	1,025,611	2,619
	Nilphamari	164,200	1,550,686	944	332,646	144,427	13,725	21,642	360,690	326,240	1,565,370	666
	Pabna	237,100	2,153,921	908	442,049	120,768	21,310	13,891	389,254	354,713	1,904,687	3,647
	Panchaghar	140,400	829,374	591	177,905	89,024	12,552	10,234	257,170	210,519	832,383	1,898
	Rajshahi	240,700	2,262,483	940	498,152	103,707	19,257	4,903	329,092	341,113	1,884,600	3,819
	Rangpur	230,800	2,534,365	1,098	579,815	216,396	22,691	18,192	574,006	466,946	2,923,819	949
	Serajganj	249,800	2,707,011	1,084	563,195	135,721	16,104	16,213	461,931	274,212	2,432,841	3,756
	Thakurgaon	180,900	1,196,429	661	256,034	152,082	27,606	6,472	415,144	373,629	1,206,222	2,653
	Subtotal- E	*3,451,200*	*29,992,955*	*869*	*6,601,007*	*2,643,403*	*287,020*	*178,818*	*6,951,761*	*5,716,184*	*34,165,898*	*41,361*
Sylhet	Habiganj	263,600	1,757,331	667	321,954	163,187	2,928	1,000	374,091	138,315	1,672,586	1,792
	Maulavibazar	279,900	1,604,028	573	291,663	115,038	306	150	326,238	167,663	1,371,910	2,256
	Sunamganj	367,000	1,968,669	536	345,190	187,260	1,284	966	439,466	133,192	1,893,327	2,522
	Sylhet	348,900	2,569,788	737	420,564	170,648	467	197	461,892	129,480	2,322,510	2,500
	Subtotal- F	*1,259,400*	*7,899,816*	*627*	*1,379,371*	*636,132*	*4,985*	*2,313*	*1,601,687*	*568,650*	*7,260,333*	*9,070*
Grand Total (A-F)		**14,756,400**	**123,151,246**	**835**	**25,362,321**	**8,431,227**	**615,947**	**527,731**	**22,294,875**	**14,609,758**	**126,667,815**	**143,860**

Source : 1. Demographic data: Population Census 2001, Preliminary Report. BBS

2. Agricultural data: Yearbook of Agricultural Statistics of Bangladesh, 1999. BBS

Table 2.2.3 Historical Performance of Structure of Gross Domestic Product of Bangladesh by Major Industry Activity (at Current Prices)

(Unit : %)

Industrial Origin	Sector	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02	Growth of Share
Agriculture	Agriculture and Forestry	25.6	21.7	20.6	21.2	20.3	20.2	19.8	20.3	19.5	18.6	18.1	-7.5
	Fishing	3.8	4.6	5.0	5.2	5.4	5.6	5.6	5.9	6.0	5.5	5.2	1.4
	Sub-Total	*29.4*	*26.3*	*25.6*	*26.4*	*25.7*	*25.8*	*25.4*	*26.2*	*25.5*	*24.1*	*23.3*	*-6.1*
Industry	Mining and Quarrying	0.9	1.1	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.1	1.1	0.2
	Manufacturing	13.9	14.9	15.3	15.3	15.4	15.6	16.2	15.5	15.2	15.6	15.7	1.8
	Electricity, Gas, and Water Supply	1.6	1.6	1.6	1.5	1.5	1.5	1.4	1.3	1.3	1.4	1.4	-0.2
	Constructuin	6.1	6.2	6.4	6.6	6.9	7.0	7.2	7.4	7.7	7.9	8.0	1.9
	Sub-Total	*22.5*	*23.8*	*24.3*	*24.6*	*24.9*	*25.1*	*25.8*	*25.2*	*25.3*	*25.9*	*26.3*	*3.8*
Service	Wholesale and Retail Trade	12.3	12.4	12.5	12.9	12.9	12.7	12.9	12.8	12.8	13.3	13.5	1.3
	Hotel and Restaurant	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.1
	Transport, Stoarage and Communication	9.7	9.9	9.7	9.2	9.1	9.0	8.7	8.5	8.6	9.0	9.2	-0.5
	Financial Intermediation	1.4	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.2
	Retail Estate, Renting and Business Service	8.6	9.0	9.2	8.9	9.5	9.4	9.2	9.2	9.2	9.1	9.2	0.6
	Public Administation and Defense	2.2	2.6	2.6	2.5	2.5	2.5	2.6	2.6	2.7	2.7	2.8	0.5
	Education	2.0	2.1	2.2	2.1	2.1	2.1	2.1	2.2	2.4	2.4	2.4	0.4
	Health and Social Service	2.3	2.4	2.4	2.3	2.3	2.3	2.3	2.3	2.4	2.3	2.3	0.0
	Community, Social and Personal Service	9.1	9.4	9.3	8.9	9.0	8.9	8.8	8.7	8.9	8.8	8.8	-0.3
	Sub-Total	*48.1*	*49.9*	*50.0*	*49.1*	*49.5*	*49.1*	*48.7*	*48.7*	*49.2*	*50.0*	*50.4*	*2.3*
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0

Table 2.2.4 Historical Performance of Annual Growth Rate of Gross Domestic Product of Bangladesh by Major Industry Activity (at Current Prices)

(Unit : %)

Industrial Origin	Sector	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02
Agriculture	Agriculture and Forestry	-11.33	2.72	15.26	4.62	8.04	8.82	12.73	3.96	2.10	3.81
	Fishing	24.93	19.53	15.93	12.05	12.77	12.79	14.82	9.52	-1.96	2.55
	Sub-Total	-6.62	5.64	15.39	6.09	9.03	9.67	13.19	5.21	1.15	3.52
Industry	Mining and Quarrying	20.82	7.81	12.74	8.07	7.85	8.42	5.88	11.85	14.22	10.82
	Manufacturing	12.04	11.02	12.40	9.70	9.85	15.55	4.84	6.27	9.75	7.88
	Electricity, Gas, and Water Supply	8.90	8.23	7.39	5.84	6.36	3.51	7.37	8.25	8.93	9.15
	Constructuin	6.78	10.42	16.54	13.44	10.64	13.88	12.74	12.78	9.72	8.67
	Sub-Total	10.75	10.53	13.16	10.40	9.77	14.09	7.22	8.50	9.88	8.31
Service	Wholesale and Retail Trade	5.87	9.15	15.37	9.19	6.94	12.74	9.61	7.24	11.22	9.39
	Hotel and Restaurant	6.80	10.21	9.89	10.64	5.58	11.94	13.87	11.11	8.71	8.76
	Transport, Stoarage and Communication	6.53	6.15	6.64	7.08	7.60	7.43	7.77	9.43	12.08	9.09
	Financial Intermediation	10.04	11.26	11.96	12.05	9.63	8.42	12.14	8.72	7.21	7.12
	Retail Estate, Renting and Business Service	9.83	10.50	9.17	15.34	7.89	8.18	11.09	7.94	5.80	7.29
	Public Administation and Defense	19.92	8.84	9.06	8.93	10.02	12.26	11.93	12.28	7.40	7.98
	Education	12.32	9.85	8.81	7.53	9.25	14.59	14.05	14.16	8.65	8.48
	Health and Social Service	10.05	7.81	7.15	7.66	8.34	10.87	10.77	11.04	6.43	5.93
	Community, Social and Personal Service	8.34	7.19	7.38	9.34	7.60	10.71	8.62	10.07	6.41	6.39
	Sub-Total	8.43	8.45	9.87	9.89	7.75	10.34	9.89	9.13	8.76	8.06
Total		4.53	8.21	12.09	9.01	8.58	11.11	10.04	7.94	7.10	7.03

Table 2.2.5 ***Historical Performance of Population and Gross Domestic Product of Bangladesh by Major Industry Activity (at Constant Prices of 1995/96)***

(Unit : Million Taka)

Industrial Origin	Sector	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02	Average Annual Growth Rate (%)
Agriculture	Agriculture and Forestry	321,970	326,319	324,200	317,932	324,382	342,458	348,080	359,368	384,251	405,114	417,847	2.6
	Fishing	63,680	69,088	74,551	79,613	85,500	91,997	100,257	110,240	120,019	114,582	116,978	6.3
	Sub-Total	385,650	395,407	398,751	397,545	409,882	434,455	448,337	469,608	504,270	519,696	534,825	3.3
Industry	Mining and Quarrying	12,330	13,428	14,119	15,482	16,691	17,286	18,281	18,522	20,277	22,254	23,880	6.8
	Manufacturing	178,391	193,771	209,554	231,517	246,351	258,795	280,908	289,882	303,679	323,976	340,176	6.7
	Electricity, Gas, and Water Supply	18,971	20,301	21,628	22,772	24,009	24,473	24,965	26,463	28,258	30,349	32,680	5.6
	Constructuin	79,886	84,671	92,525	101,372	109,993	119,500	130,833	142,503	154,590	167,952	181,228	8.5
	Sub-Total	289,578	312,171	337,826	371,143	397,044	420,054	454,987	477,370	506,804	544,531	577,964	7.2
Service	Wholesale and Retail Trade	167,672	172,835	182,433	196,948	206,076	217,374	230,382	245,377	263,282	280,212	295,988	5.8
	Hotel and Restaurant	8,054	8,455	8,876	9,318	9,782	10,269	10,936	11,664	12,473	13,346	14,214	5.8
	Transport, Stoarage and Communication	122,450	126,169	131,241	137,739	144,831	152,798	161,490	171,019	181,422	195,798	207,605	5.4
	Financial Intermediation	21,147	21,748	22,838	24,001	25,171	26,465	27,860	29,365	30,980	32,697	34,404	5.0
	Retail Estate, Renting and Business Service	132,154	136,613	141,159	146,065	151,036	156,385	162,328	168,528	174,990	180,959	187,147	3.5
	Public Administation and Defense	30,445	34,941	36,911	38,561	40,165	42,375	44,874	47,431	50,262	53,216	56,950	6.5
	Education	26,901	28,919	30,831	32,214	33,042	34,618	37,422	40,304	43,424	48,511	50,012	6.4
	Health and Social Service	31,248	32,911	34,436	35,431	36,388	37,807	39,542	41,361	43,346	45,480	47,748	4.3
	Community, Social and Personal Service	128,246	131,736	136,345	139,073	142,943	146,929	151,117	155,575	160,332	165,378	170,729	2.9
	Sub-Total	668,317	694,327	725,070	759,350	789,434	825,020	865,951	910,624	960,511	1,015,597	1,064,797	4.8
Total		1,343,545	1,401,905	1,461,647	1,528,038	1,596,360	1,679,529	1,769,275	1,857,602	1,971,585	2,079,824	2,177,586	4.9
Population(in Million)		106.3	107.9	109.5	111.1	112.8	114.4	116.1	117.9	119.6	121.4	123.2	1.5
Per Capita GDP		12,639	12,995	13,350	13,752	14,157	14,676	15,234	15,760	16,482	17,132	17,675	3.4

Source : 1.Statistical Yearbook of Bangladesh, 2000, Bangladesh Bureau of Statistics (BBS)

2. Statistical Pocketrbook , Bangladesh 2001, Bangladesh Bureau of Statistics (BBS)

Table 2.2.6 Historical Performance of Structure of Gross Domestic Product of Bangladesh by Major Industry Activity (at Constant Prices of 1995/96)

(Unit : %)

Industrial Origin	Sector	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02	Growth of Share
Agriculture	Agriculture and Forestry	24.0	23.3	22.2	20.8	20.3	20.4	19.7	19.3	19.5	19.5	19.2	-4.8
	Fishing	4.7	4.9	5.1	5.2	5.4	5.5	5.7	5.9	6.1	5.5	5.4	0.6
	Sub-Total	28.7	28.2	27.3	26.0	25.7	25.9	25.3	25.3	25.6	25.0	24.6	-4.1
Industry	Mining and Quarrying	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	0.2
	Manufacturing	13.3	13.8	14.3	15.2	15.4	15.4	15.9	15.6	15.4	15.6	15.6	2.3
	Electricity, Gas, and Water Supply	1.4	1.4	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.5	1.5	0.1
	Constructuin	5.9	6.0	6.3	6.6	6.9	7.1	7.4	7.7	7.8	8.1	8.3	2.4
	Sub-Total	21.6	22.3	23.1	24.3	24.9	25.0	25.7	25.7	25.7	26.2	26.5	5.0
Service	Wholesale and Retail Trade	12.5	12.3	12.5	12.9	12.9	12.9	13.0	13.2	13.4	13.5	13.6	1.1
	Hotel and Restaurant	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.1
	Transport, Stoarage and Communication	9.1	9.0	9.0	9.0	9.1	9.1	9.1	9.2	9.2	9.4	9.5	0.4
	Financial Intermediation	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.0
	Retail Estate, Renting and Business Service	9.8	9.7	9.7	9.6	9.5	9.3	9.2	9.1	8.9	8.7	8.6	-1.2
	Public Administation and Defense	2.3	2.5	2.5	2.5	2.5	2.5	2.5	2.6	2.5	2.6	2.6	0.3
	Education	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.2	2.2	2.3	2.3	0.3
	Health and Social Service	2.3	2.3	2.4	2.3	2.3	2.3	2.2	2.2	2.2	2.2	2.2	-0.1
	Community, Social and Personal Service	9.5	9.4	9.3	9.1	9.0	8.7	8.5	8.4	8.1	8.0	7.8	-1.7
	Sub-Total	49.7	49.5	49.6	49.7	49.5	49.1	48.9	49.0	48.7	48.8	48.9	-0.8
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0

Table 2.2.7 Historical Performance of Annual Growth Rate of Gross Domestic Product of Bangladesh by Major Industry Activity (At Constant Prices of 1995/96)

(Unit : %)

Industrial Origin	Sector	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02
Agriculture	Agriculture and Forestry	1.4	-0.6	-1.9	2.0	5.6	1.6	3.2	6.9	5.4	3.1
	Fishing	8.5	7.9	6.8	7.4	7.6	9.0	10.0	8.9	-4.5	2.1
	Sub-Total	2.5	0.8	-0.3	3.1	6.0	3.2	4.7	7.4	3.1	2.9
Industry	Mining and Quarrying	8.9	5.1	9.7	7.8	3.6	5.8	1.3	9.5	9.7	7.3
	Manufacturing	8.6	8.1	10.5	6.4	5.1	8.5	3.2	4.8	6.7	5.0
	Electricity, Gas, and Water Supply	7.0	6.5	5.3	5.4	1.9	2.0	6.0	6.8	7.4	7.7
	Constructuin	6.0	9.3	9.6	8.5	8.6	9.5	8.9	8.5	8.6	7.9
	Sub-Total	7.8	8.2	9.9	7.0	5.8	8.3	4.9	6.2	7.4	6.1
Service	Wholesale and Retail Trade	3.1	5.6	8.0	4.6	5.5	6.0	6.5	7.3	6.4	5.6
	Hotel and Restaurant	5.0	5.0	5.0	5.0	5.0	6.5	6.7	6.9	7.0	6.5
	Transport, Stoarage and Communication	3.0	4.0	5.0	5.1	5.5	5.7	5.9	6.1	7.9	6.0
	Financial Intermediation	2.8	5.0	5.1	4.9	5.1	5.3	5.4	5.5	5.5	5.2
	Retail Estate, Renting and Business Service	3.4	3.3	3.5	3.4	3.5	3.8	3.8	3.8	3.4	3.4
	Public Administation and Defense	14.8	5.6	4.5	4.2	5.5	5.9	5.7	6.0	5.9	7.0
	Education	7.5	6.6	4.5	2.6	4.8	8.1	7.7	7.7	11.7	3.1
	Health and Social Service	5.3	4.6	2.9	2.7	3.9	4.6	4.6	4.8	4.9	5.0
	Community, Social and Personal Service	2.7	3.5	2.0	2.8	2.8	2.9	3.0	3.1	3.1	3.2
	Sub-Total	3.9	4.4	4.7	4.0	4.5	5.0	5.2	5.5	5.7	4.8
Total		4.3	4.3	4.5	4.5	5.2	5.3	5.0	6.1	5.5	4.7

Table 2.2.8 Consolidated Receipts and Expenfiture of the Government

(Unit : Million Taka)

Iems	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00 (RE)	2000/01	2001/02	Average Annual Growth Rate (%)
1. Revenue									
(a) Revenue Receit									
(i) Tax	120,536	121,241	142,614	153,900	161,671	170,957	194,902	220,234	9.0
(ii) Non-Tax	28,363	30,139	30,091	35,087	42,997	42,493	46,824	52,155	9.1
Sub-total	148,899	151,380	172,705	188,987	204,668	213,450	241,726	272,389	9.0
(b) Development Receipt									
(i) Project	47,290	46,780	50,107	51,390	59,250	69,430	76,060	85,030	8.7
(ii) Food and Commodities	31,600	22,380	16,030	14,170	28,285	18,890	13,160	17,190	-8.3
(iii) Internal Resources	3,940	11,960	14,303	15,910	32,095	57,570	65,520	48,450	43.1
Sub-total	82,830	81,120	80,440	81,470	119,630	145,890	154,740	150,670	8.9
Total	231,729	232,500	253,145	270,457	324,298	359,340	396,466	423,060	9.0
2. Expenditure									
(a) Revenue Expenditure									
(i) Wages and Salaries	38,568	41,834	43,255	49,747	53,671	59,327	60,974	66,782	8.2
(ii) Commodities and services	20,368	24,017	26,919	29,819	29,023	32,533	37,095	42,872	11.2
(iii) Transfer	38,568	45,809	44,016	60,251	78,091	85,118	99,337	101,219	14.8
(iv) Other Services	8,175	9,173	9,541	8,633	7,998	8,842	9,214	9,506	2.2
Sub-total	105,679	120,833	123,731	148,450	168,783	185,820	206,620	220,379	11.1
(b) Devlopment Expenditure									
(i) Agriculture, Flood Control, Water Resouces and Rural Institution	20,928	20,365	25,719	29,355	27,530	36,760	36,828	27,031	3.7
(ii) Industry	2,031	1,763	1,762	593	980	2,560	5,410	2,397	2.4
(iii) Transport and Communication	28,403	27,008	24,519	20,175	26,360	32,000	37,910	33,156	2.2
(iv) Other Services	51,668	50,821	58,410	60,247	70,220	83,390	81,360	73,416	5.1
Sub-total	103,030	99,957	110,410	110,370	125,090	154,710	161,508	136,000	4.0
Total	208,709	220,790	234,141	258,820	293,873	340,530	368,128	356,379	7.9
Balance(Revenue Receipts-Total Expenditure)	-59,810	-69,410	-61,436	-69,833	-89,205	-127,080	-126,402	-83,990	5.0
Balance(Revenue Receipts-Revenue Expenditure)	43,220	30,547	48,974	40,537	35,885	27,630	35,106	52,010	2.7
Balance(Total Revenue - Total Expenditure)	23,020	11,710	19,004	11,637	30,425	18,810	28,338	66,681	16.4

Source : National Expenditure Section, BBS

Note:1. The present figures of development receipts shown in the table indicate revised budget estimates. As the actaual data are not available, the receipts and expenditures on development budget may differ.

2. RE stands for revised estimates and BE stands for budget estimates.

Table 2.2.9 Share Structure of Consolidated Receipts and Expenfiture of National Budget

(Unit : %)

Iems	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	Average Annual Increase of Share
1. Revenue									
(a) Revenue Receit									
(i) Tax	52	52	56	57	50	48	49	52	0.01
(ii) Non-Tax	12	13	12	13	13	12	12	12	0.01
Sub-total	64	65	68	70	63	59	61	64	0.02
(b) Development Receipt									
(i) Project									
(ii) Food and Commodities	14	10	6	5	9	5	3	4	-1.37
(iii) Internal Resources	2	5	6	6	10	16	17	11	1.39
Sub-total	36	35	32	30	37	41	39	36	-0.02
Total	100	100	100	100	100	100	100	100	0.00
2. Expenditure									
(a) Revenue Expenditure									
(i) Wages and Salaries	18	19	18	19	18	17	17	19	0.04
(ii) Commodities and services	10	11	11	12	10	10	10	12	0.32
(iii) Transfer	18	21	19	23	27	25	27	28	1.42
(iv) Other Services	4	4	4	3	3	3	3	3	-0.18
Sub-total	51	55	53	57	57	55	56	62	1.60
(b) Devlopment Expenditure									
(i) Agriculture, Flood Control, Water Resouces and Rural Institution	10	9	11	11	9	11	10	8	-0.35
(ii) Industry	1	1	1	0	0	1	1	1	-0.04
(iii) Transport and Communication	14	12	10	8	9	9	10	9	-0.62
(iv) Other Services	25	23	25	23	24	24	22	21	-0.59
Sub-total	49	45	47	43	43	45	44	38	-1.60
Total	100	100	100	100	100	100	100	100	0.00

Table 2.2.10 Development Expenditure of the Government by Sector

(Unit : Million Taka)

	Items	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	Average Annual Growth Rate (%)
1	Agriculture	4,415	4,361	5,858	5,654	6,048	6,296	6,080	7,250	7,314	6,264	4.0
2	Rural Development	5,783	4,972	7,198	7,064	9,687	13,926	12,680	18,850	19,679	13,415	9.8
3	Flood Control and Water Resources	9,806	9,166	7,872	7,647	9,984	9,133	8,770	10,660	9,835	7,352	-3.1
4	Industry	2,558	1,761	2,031	1,963	1,762	593	980	2,560	5,410	2,397	-0.7
5	Power and Natural Resources	24,412	26,388	14,509	14,522	17,874	13,940	20,810	26,530	23,719	20,344	-2.0
6	Transport	7,356	16,214	22,998	22,231	22,004	17,648	22,450	26,900	32,988	26,856	15.5
7	Communication	2,789	8,788	5,405	4,777	2,515	2,527	3,910	5,100	4,922	6,300	9.5
8	Education and Training	745	7,050	14,992	14,623	15,507	15,416	17,390	20,640	22,575	19,143	43.4
9	Health, Population Control and Familiy Welfare	5,876	8,073	8,736	8,640	10,179	6,735	10,210	12,460	11,783	12,261	8.5
10	Physical Palnning and Housing	1,204	2,353	10,687	9,585	11,745	18,933	18,580	19,880	19,330	18,050	35.1
11	Others	556	694	2,744	3,451	3,105	5,223	3,230	3,880	3,953	3,624	23.2
	Total	65,500	89,820	103,030	100,157	110,410	110,370	125,090	154,710	161,508	136,006	8.5

Source : National Expenditure Section, BBS

Table 2.2.11 Financing of the Development Expenditure of the Government

(Unit : Million Taka)

	Items	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01 (BE)	Average Annual Growth Rate (%)
1	Development Expenditure Financing	60,240	65,400	89,830	111,500	100,160	117,000	122,000	140,000	165,000	175,000	12.6
2	Domestic Resources	0	0	0	0	0	0	0	0	0	0	
(1)	Revenue Surplus	16,170	25,500	31,300	39,100	36,980	46,100	50,800	29,350	29,010	45,660	12.2
(2)	Net Domestic Capital Receipt	1,380	150	780	4,020	9,560	13,090	11,620	12,800	14,020	9,410	23.8
(3)	Accumulated Balance Autonomous Bodies Through Debentures	3,620	2,600	1,960	1,820	1,500	1,550	1,700	1,840	2,500	2,500	-4.0
	Total Domestic Resources	21,170	28,250	34,040	44,940	48,040	60,740	64,120	43,990	45,530	57,570	11.8
3	Foreign Assistance											
(1)	Project Assistance	40,500	43,680	43,600	46,400	44,600	49,240	51,390	59,250	68,430	78,740	7.7
(2)	Non-Project Assistance	9,880	14,230	15,700	13,020	11,920	6,840	9,980	18,540	10,110	9,630	-0.3
(3)	Net-Resources from Food Account	-50	-4,950	-1,940	1,460	-2,240	9,960	5,670	11,050	8,780	5,840	-
	Total Foreign Assistance	50,330	52,960	57,360	60,880	54,280	66,040	67,040	88,840	87,320	94,210	7.2
4	Total Resources	71,500	81,210	91,400	105,820	102,320	126,780	131,160	132,830	132,850	151,780	8.7
5	Balance	11,260	15,810	1,570	-5,680	2,160	9,780	9,160	-7,170	-32,150	-23,220	-

Source : National Expenditure Section, BBS

Tabe 2.2.12 Commitment and Disbursement of Foreign Economic Assistance

(Unit : Million US$)

Iems			1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Commitment	Grants	Food Aid	226	178	83	132	133	138	52	269	50	245
		Commodity Aid	185	232	117	269	160	168	140	161	174	222
		Project Aid	730	325	263	460	571	537	392	864	395	470
		Sub-total	1,141	735	463	861	864	843	584	1,294	619	937
	Loans	Food Aid	-	-	-	-	-	-	-	-	-	-
		Commodity Aid	391	104	248	85	3	3	78	202	-	-
		Project Aid	384	436	1,698	666	412	816	1,128	1,582	856	1,115
		Sub-total	775	540	1,946	751	415	819	1,206	1,784	856	1,115
	Total		1,916	1,275	2,409	1,612	1,279	1,662	1,790	3,078	1,475	2,052
Disbursment	Grants	Food Aid	241	121	118	137	138	101	93	176	142	51
		Commodity Aid	192	208	184	227	182	248	77	119	280	145
		Project Aid	383	490	408	526	357	387	333	374	304	309
		Sub-total	816	819	710	890	677	736	503	669	726	505
	Loans	Food Aid	-	-	-	-	-	-	-	-	-	-
		Commodity Aid	194	164	267	106	47	15	42	205	3	39
		Project Aid	601	692	582	743	719	730	706	662	859	825
		Sub-total	795	856	849	849	766	745	748	867	862	864
	Total		1,611	1,675	1,559	1,739	1,443	1,481	1,251	1,536	1,588	1,369

Source : External Resources Division, Ministry of Finance

Table 2.2.13 Commitment of Foreign Economic Assistance to Bangladesh

(Unit : Million US$)

Country/Agency	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	Average Annual Growth Rate (%)
Australia	17	7	8	8	9	12	9	7	7	7	-9.4
A.D.B.	439	261	529	166	159	265	419	254	271	231	-5.2
Belgium	1	-	2	-	-	-	-	5	-		-
Canada	113	-	-	44	8	12	30	55	13	16	-21.4
China	-	6	9	-	-	19	24	13	12	24	-
Denmark	8	20	19	56	6	42	31	32	44	85	20.9
E.E.C./E.U.	186	-	56	45	114	41	22	68	76	49	-9.5
France	36	29	13	26	30	12	14	4	5	5	-19.7
Finland	4	6	-	2	-	-	-	-	-		-
Germany(FRG)	97	13	114	5	113	34	42	-	42	28	-8.9
I.D.A.	177	252	598	194	232	319	641	1038	178	282	0.1
I.D.B./I..S./D.B.	10	-	29	10	10	13	24	10	37	25	15.6
I.F.A.D.	27	-	9	16	10	19	32	18	-		-
India	12	-	-	-	-	-	-	46	-		-
Italy	78	-	-	-	-	-	-	-	24		-12.3
Japan	242	242	561	591	170	312	204	156	335	340	3.7
Kuwait	-	-	33			31	30	21	58	33	-
Netherlands	54	79	16	10	60	38	10	19	18	19	-11.5
Norway	44	29	23	20	22	8	40	38	2	8	-29.1
NDE	-	-	-	-	-	-	6		4		-
O.P.E.C.	8	13	15	16			15	18			-
Pakistan	-	-	-	-	-	-	-	-	-		-
Switzerland	4	13		5	4	17		15	1		-14.3
Saudi Arabia	126	-	-	-	-	-	-	-	11		-23.7
Suppliers Credit	-	10	264	97				283	103		-
Sweden	10	21	17	3	11	39	34	48	17	0.5	6.1
South Korea	-	-	14	1		31	-	-	-		-
Spain	-	-	-	-	-	-	11	85			-
U.K.	43	35	18	86	10	10	67	155	122	11	12.3
U.S.A.	161	89	61	35	33	234	37	81	35	86	-15.6
U.N. System	19	150	3	42	29	153	48	179	59	190	13.4
UNICEF	-	-	-	119	250	-	-	-	-	203	-
U.A.E.	-	-	-	16	-	-	-	-	-		-
Others	-	-	-	-	-	-	-	-	-	410	-
Total	1916	1275	2411	1613	1280	1661	1790	2648	1474	2,053	-2.9

Source: 1.Flow of External Resources in Bangladesh, As of June 30, 2000.(2000 Statistical Yearbook of Bangladesh, BBS.

2. Statistical Pocketbook, Bangladesh 2001, BBS

Note : The meanings of abreviatiuon as follows.

Table 2.2.14 Disbursement of Foreign Economic Assistance to Bangladesh

(Unit : Million US$)

Country/Agency	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Australia	9	7	12	10	11	16	9	7	8	7
A.D.B.	421	275	308	337	279	255	240	217	283	236
Belgium	5	3	5	2	3	1	-	-	-	
Canada	61	94	32	47	25	30	14	27	28	19
China	4	11	-	-	-	10	2	-	18	26
Denmark	40	10	22	31	14	23	19	33	29	5
E.E.C./E.U.	28	47	54	64	91	62	57	39	5	32
France	28	17	20	30	10	27	31	11	1	6
Finland	2	16	-	2	4	3	-	-	-	
Germany(FRG)	85	61	33	112	64	34	49	37	21	43
I.D.A.	240	329	379	286	226	314	332	477	354	299
I.D.B./I..S./D.B.	3	9	8	6	11	19	14	12	17	15
I.F.A.D.	23	9	6	8	6	9	13	11	15	10
India	-	-	1	-	-	-	-	7	4	20
Italy	1	5	11	11	1	-	-	-	-	-
Japan	153	264	294	357	331	368	172	235	391	316
Kuwait	-	8	-	-	10	10	3	6	14	33
Netherlands	25	49	40	18	33	72	21	43	28	46
Norway	27	35	34	34	30	17	19	10	19	17
NDE	-	-	-	-	-	-	-	-	1	-
O.P.E.C.	3	4	3	6	16	17	11	3	8	-
Pakistan	-	2	-	-	-	-	-	-	-	-
Switzerland	1	3	13	5	2	3	2	9	4	-
Saudi Arabia	46	60	25	19	31	10	14	4	6	0.4
Suppliers Credit	38	107	28	57	98	12	42	46	43	
Sweden	25	44	19	13	5	22	27	22	20	16
South Korea	-	-	-	-	-	1	-	19	9	-
U.K.	59	52	39	53	33	21	35	52	61	53
U.S.A.	139	69	107	115	51	35	26	69	92	39
U.N. System	108	71	53	64	37	27	74	118	81	23
U.S.S.R.	1	-	-	-	-	-	-	-	-	-
UNICEF	33	15	12	50	21	60	22	19	27	49
U.A.E.	-	-	-	2	2	2	4	3	-	-
Others	-	-	-	-	-	-	-	-	-	59
Total	1608	1676	1558	1739	1445	1480	1252	1536	1,587	1,369

Source: 1.Flow of External Resources in Bangladesh, As of June 30, 2000.(2000 Statistical Yearbook of Bangladesh, BBS.

Table 2.2.15 Comparison of GDP Growth Rate between Target and Realized

(Unit: %)

Plan	Annual Growth Rate Target (%)	Realized Annual Growth Rate (%)	Target Achievement Ratio (%)
First Five Year Plan(1973-78)	5.50	4.00	72.7
Two Year Plan(1978-80)	5.60	3.50	62.5
Second Five Year Plan(1980-85)	5.40	3.80	70.4
Third Five Year Plan(1985-90)	5.40	3.80	70.4
Fourth Five Year Plan(1990-95)	5.00	4.15	83.0
Fifth Five Year Plan(1997-2002)	7.00	5.64	80.6

Table 2.2.16 Achievement of Target Growth Rate of GDP in the Fifth Five Year Plan

Year	Fifth Year Plan		Achievement (Actual)		Achievement Ratio of Target Growth Rate (%)
	GDP (1996/97 prices) [million Taka]	Target Growth Rate (%)	GDP (1995/96 prices) [million Taka]	Actual Growth Rate (%)	
1996/97 (Base Year)	1,402,580	5.70	1,679,529	5.20	91.2
1997/98	1,486,735	6.00	1,769,275	5.30	88.3
1998/99	1,580,399	6.30	1,857,602	5.00	79.4
1999/00	1,687,866	6.80	1,971,585	6.10	89.7
2000/01	1,816,144	7.60	2,091,387	6.10	80.3
2001/02	1,967,191	8.32	-	-	-
Average *	1,707,667	7.00	1,922,462	5.63	80.3

Source : The Fifth Five Year Plan, 1997-2002, Planning Commission, Ministry of Planning

Note : * The average was calculated for the values during the Plan Period (1997/8-2001/02).

Table 2.2.17 Major Goal Posts in Poverty and Social Indicators under an Accelerated Social Development Strategy with 2000 as the Benchmark Year for Target Setting

Indicators	1990	2000 (Bench Mark Data)	Annual Progress Over 1990-2000 (%)	2004	2006	2010	2015	Annual Progress Over 2000-2015 (%)
Income poverty(%)	59	50	-1.5	45	43	35	25	-3.3
Extreme Poverty(%)	28	19	-3.2	15	13	9	5	-4.9
Adult Literacy(%)	35	56	6.0	64	69	79	90	4.0
Primary Enrolment(%)	56	75	3.4	81	84	92	100	2.2
Secondary Enrollment(%)	28	65	13.2	71	80	85	95	3.1
Infant Mortality Rate (IMR) (Person/1,000 Live Birth)	94	66	-3.0	56	48	37	22	-4.4
Under-Five Mortality Rate (Person/1,000 Live Birth)	106	94	-1.3	80	70	52	31	-4.5
Maternal Mortality Rate(MMR) (Person/1,000 Live Mother)	480	320	-3.3	295	275	240	147	-3.6
Life Expectancy(Year)	56	61	0.9	64	66	69	73	1.3
Pulation Growth(%)	2.1	1.6	-	1.5	1.5	1.4	1.3	-
Children Underweight(%)	67	51	-2.4	48	42	34	26	-3.3
Redction in Gender Disparity (% of Male)								
Female Literacy	80	Eradicate by 200-2015						
Female Enrollment at Tertially Level	33							
Female Underweight, Moderate or Severe <5 Years	8							
Female Underweight, Severe <5 Years	26							
Female Mortality	133							

Surce : "A National Strategy for Economic Growth Poverty Reduction and Social Development", Economic Relations Division, Minstry of Fiance, January 2003

Table 2.2.18 Population Projection by Division

(Unit:1,000 persons)

Division	1981	1991	2001	2010	2020	Average Annual Growth Rate (%)			
						1981/91	1991/01	2001/1	2010/20
Barisal	6,509	7,465	8,113	9,528	10,807	1.38	0.84	1.80	1.27
Chittagong	16,938	20,549	23,999	27,979	31,480	1.95	1.56	1.72	1.19
Sylhet	5,656	6,774	7,900	9,213	10,369	1.82	1.55	1.72	1.19
Dhaka	26,226	32,711	38,678	45,273	51,233	2.23	1.69	1.76	1.24
Khulna	10,650	12,678	14,469	16,911	19,079	1.76	1.33	1.75	1.21
Rajshahi	21,141	26,210	29,992	35,042	39,520	2.17	1.36	1.74	1.21
Bangladesh	87,120	106,387	123,151	143,947	162,489	2.02	1.47	1.75	1.22

Source : 1. 2000 Statistical Yearbook of Bangladesh, BBS.

2. Bangladesh Population Census 1991, Volume 1, Analytical Report.

Table 2.2.19 Projection of Population Density by Division

(Unit: Person/km^2)

Division	1981	1991	2001	2010	2020	Average Annual Growth Rate (%)			
						1981/91	1991/01	2001/10	2010/20
Barisal	370	423	457	538	610	1.35	0.78	1.81	1.27
Chittagong	502	608	711	828	932	1.95	1.56	1.72	1.19
Sylhet	449	538	627	732	823	1.82	1.55	1.72	1.19
Dhaka	843	1,051	1,243	1,455	1,646	2.23	1.69	1.76	1.24
Khulna	478	569	650	759	857	1.76	1.33	1.75	1.21
Rajshahi	613	759	869	1,015	1,145	2.17	1.36	1.74	1.21
Bangladesh	590	721	835	975	1,101	2.02	1.47	1.75	1.22

Source : 1. 2000 Statistical Yearbook of Bangladesh, BBS.

2. Bangladesh Population Census 1991, Volume 1, Analytical Report.

Table 2.2.20 Projection of Population and Gross Domestic Product of Bangladesh by Major Industry Activity (at Constant Prices of 1995/96): Low Growth Scenario

(Unit : Million Taka)

Industrial Origin	Sector	1991/92	1995/96	2000/01	2005/06	2010/11	2020/21	Average Annual Growth Rate (%)					
								1991/1995	1995/2000	1991/2000	2000/2005	2005/2010	2010/2020
Agriculture	Agriculture and Forestry	321,970	324,382	399,601	464,496	538,697	685,436	0.2	4.3	2.4	3.1	3.0	2.4
	Fishing	63,680	85,500	130,097	177,479	227,363	381,099	7.6	8.8	8.3	6.4	5.1	5.3
	Sub-Total	385,650	409,882	529,698	641,974	766,061	1,066,535	1.5	5.3	3.6	3.9	3.6	3.4
Industry	Mining and Quarrying	12,330	16,691	22,417	28,938	36,848	53,864	7.9	6.1	6.9	5.2	5.0	3.9
	Manufacturing	178,391	246,351	331,308	427,678	544,593	811,885	8.4	6.1	7.1	5.2	5.0	4.1
	Electricity, Gas, and Water Supply	18,971	24,009	30,240	37,262	44,155	76,195	6.1	4.7	5.3	4.3	3.5	5.6
	Constructuin	79,886	109,993	166,849	230,760	308,105	568,822	8.3	8.7	8.5	6.7	6.0	6.3
	Sub-Total	289,578	397,044	550,814	724,638	933,700	1,510,765	8.2	6.8	7.4	5.6	5.2	4.9
Service	Wholesale and Retail Trade	167,672	206,076	279,724	361,089	482,117	769,725	5.3	6.3	5.9	5.2	6.0	4.8
	Hotel and Restaurant	8,054	9,782	13,346	16,677	20,792	33,195	5.0	6.4	5.8	4.6	4.5	4.8
	Transport, Stoarage and Communication	122,450	144,831	192,770	248,842	332,248	584,535	4.3	5.9	5.2	5.2	6.0	5.8
	Financial Intermediation	21,147	25,171	32,741	38,312	44,729	68,005	4.5	5.4	5.0	3.2	3.1	4.3
	Retail Estate, Renting and Business Service	132,154	151,036	181,735	213,665	250,633	381,052	3.4	3.8	3.6	3.3	3.2	4.3
	Public Administation and Defense	30,445	40,165	53,299	62,075	71,797	98,916	7.2	5.8	6.4	3.1	3.0	3.3
	Education	26,901	33,042	46,507	61,437	80,976	156,843	5.3	7.1	6.3	5.7	5.7	6.8
	Health and Social Service	31,248	36,388	45,475	52,216	59,819	91,842	3.9	4.6	4.3	2.8	2.8	4.4
	Community, Social and Personal Service	128,246	142,943	165,278	185,322	204,988	282,415	2.7	2.9	2.9	2.3	2.0	3.3
	Sub-Total	668,317	789,434	1,010,875	1,239,637	1,548,099	2,466,527	4.3	5.1	4.7	4.2	4.5	4.8
Total		1,343,545	1,596,360	2,091,387	2,606,249	3,247,860	5,043,827	4.4	5.6	5.0	4.5	4.5	4.5
Population(in Million)		106.3	112.8	121.4	132.2	143.9	162.5	1.5	1.5	1.5	1.7	1.7	1.2
Per Capita GDP		12,639	14,157	17,228	18,943	22,563	31,041	2.9	4.0	3.5	1.9	3.6	3.2

Source : Statistical Yearbook of Bangladesh, 2000, Bangladesh Bureau of Statistics (BBS)

Note : The figure of 2000/01 is preliminary.

Table 2.2.21 Projection of Population and Gross Domestic Product of Bangladesh by Major Industry Activity (at Constant Prices of 1995/96): Medium Growth Scenario

(Unit : Million Taka)

Industrial Origin	Sector	1991/92	1995/96	2000/01	2005/06	2010/11	2020/21	Average Annual Growth Rate (%)					
								1991/1995	1995/2000	1991/2000	2000/2005	2005/2010	2010/2020
Agriculture	Agriculture and Forestry	321,970	324,382	399,601	487,150	603,538	845,784	0.2	4.3	2.4	4.0	4.4	3.4
	Fishing	63,680	85,500	130,097	186,135	231,451	427,276	7.6	8.8	8.3	7.4	4.5	6.3
	Sub-Total	385,650	409,882	529,698	673,284	834,989	1,273,059	1.5	5.3	3.6	4.9	4.4	4.3
Industry	Mining and Quarrying	12,330	16,691	22,417	30,349	40,137	64,619	7.9	6.1	6.9	6.2	5.8	4.9
	Manufacturing	178,391	246,351	331,308	448,537	593,202	973,997	8.4	6.1	7.1	6.2	5.8	5.1
	Electricity, Gas, and Water Supply	18,971	24,009	30,240	39,079	48,096	91,409	6.1	4.7	5.3	5.3	4.2	6.6
	Constructuin	79,886	109,993	166,849	242,014	335,606	682,401	8.3	8.7	8.5	7.7	6.8	7.4
	Sub-Total	289,578	397,044	550,814	759,979	1,017,041	1,812,427	8.2	6.8	7.4	6.6	6.0	5.9
Service	Wholesale and Retail Trade	167,672	206,076	279,724	378,700	525,150	923,420	5.3	6.3	5.9	6.2	6.8	5.8
	Hotel and Restaurant	8,054	9,782	13,346	17,490	23,752	41,765	5.0	6.4	5.8	5.6	6.3	5.8
	Transport, Stoarage and Communication	122,450	144,831	192,770	260,979	361,904	701,252	4.3	5.9	5.2	6.2	6.8	6.8
	Financial Intermediation	21,147	25,171	32,741	40,181	51,098	85,562	4.5	5.4	5.0	4.2	4.9	5.3
	Retail Estate, Renting and Business Service	132,154	151,036	181,735	224,086	286,319	479,434	3.4	3.8	3.6	4.3	5.0	5.3
	Public Administation and Defense	30,445	40,165	53,299	65,102	78,206	118,667	7.2	5.8	6.4	4.1	3.7	4.3
	Education	26,901	33,042	46,507	64,434	92,506	197,337	5.3	7.1	6.3	6.7	7.5	7.9
	Health and Social Service	31,248	36,388	45,475	54,762	68,336	115,554	3.9	4.6	4.3	3.8	4.5	5.4
	Community, Social and Personal Service	128,246	142,943	165,278	194,361	233,090	353,683	2.7	2.9	2.9	3.3	3.7	4.3
	Sub-Total	668,317	789,434	1,010,875	1,300,095	1,720,360	3,016,674	4.3	5.1	4.7	5.2	5.8	5.8
Total		1,343,545	1,596,360	2,091,387	2,733,359	3,572,391	6,102,160	4.4	5.6	5.0	5.5	5.5	5.5
Population(in Million)		106.3	112.8	121.4	132.2	143.9	162.5	1.5	1.5	1.5	1.7	1.7	1.2
Per Capita GDP		12,639	14,157	17,228	20,677	24,817	37,554	2.9	4.0	3.5	3.7	3.7	4.2

Source : Statistical Yearbook of Bangladesh, 2000, Bangladesh Bureau of Statistics (BBS)

Note : The figure of 2000/01 is preliminary.

Table 2.2.22 Projection of Population and Gross Domestic Product of Bangladesh by Major Industry Activity (at Constant Prices of 1995/96): High Growth Scenario

(Unit : Million Taka)

Industrial Origin	Sector	1991/92	1995/96	2000/01	2005/06	2010/11	2020/21	Average Annual Growth Rate (%)					
								1991/1995	1995/2000	1991/2000	2000/2005	2005/2010	2010/2020
Agriculture	Agriculture and Forestry	321,970	324,382	399,601	522,780	676,539	1,091,055	0.2	4.3	2.4	5.5	5.3	4.9
	Fishing	63,680	85,500	130,097	199,749	289,820	615,712	7.6	8.8	8.3	9.0	7.7	7.8
	Sub-Total	385,650	409,882	529,698	722,529	966,360	1,706,766	1.5	5.3	3.6	6.4	6.0	5.9
Industry	Mining and Quarrying	12,330	16,691	22,417	32,569	46,662	86,453	7.9	6.1	6.9	7.8	7.5	6.4
	Manufacturing	178,391	246,351	331,308	481,343	689,635	1,303,087	8.4	6.1	7.1	7.8	7.5	6.6
	Electricity, Gas, and Water Supply	18,971	24,009	30,240	41,938	54,627	119,478	6.1	4.7	5.3	6.8	5.4	8.1
	Constructuin	79,886	109,993	166,849	259,716	389,989	912,561	8.3	8.7	8.5	9.3	8.5	8.9
	Sub-Total	289,578	397,044	550,814	815,565	1,180,913	2,421,579	8.2	6.8	7.4	8.2	7.7	7.4
Service	Wholesale and Retail Trade	167,672	206,076	279,724	406,399	582,260	1,178,236	5.3	6.3	5.9	7.8	7.5	7.3
	Hotel and Restaurant	8,054	9,782	13,346	18,770	28,261	57,188	5.0	6.4	5.8	7.1	8.5	7.3
	Transport, Stoarage and Communication	122,450	144,831	192,770	280,067	401,261	894,760	4.3	5.9	5.2	7.8	7.5	8.3
	Financial Intermediation	21,147	25,171	32,741	43,120	60,799	117,158	4.5	5.4	5.0	5.7	7.1	6.8
	Retail Estate, Renting and Business Service	132,154	151,036	181,735	240,476	340,675	656,475	3.4	3.8	3.6	5.8	7.2	6.8
	Public Administation and Defense	30,445	40,165	53,299	69,864	86,711	151,413	7.2	5.8	6.4	5.6	4.4	5.7
	Education	26,901	33,042	46,507	69,147	110,067	270,208	5.3	7.1	6.3	8.3	9.7	9.4
	Health and Social Service	31,248	36,388	45,475	58,768	81,309	158,225	3.9	4.6	4.3	5.3	6.7	6.9
	Community, Social and Personal Service	128,246	142,943	165,278	208,576	275,458	481,000	2.7	2.9	2.9	4.8	5.7	5.7
	Sub-Total	668,317	789,434	1,010,875	1,395,185	1,966,802	3,964,663	4.3	5.1	4.7	6.7	7.1	7.3
Total		1,343,545	1,596,360	2,091,387	2,933,278	4,114,075	8,093,008	4.4	5.6	5.0	7.0	7.0	7.0
Population(in Million)		106.3	112.8	121.4	132.2	143.9	162.5	1.5	1.5	1.5	1.7	1.7	1.2
Per Capita GDP		12,639	14,157	17,228	22,190	28,581	49,807	2.9	4.0	3.5	5.2	5.2	5.7

Source : Statistical Yearbook of Bangladesh, 2000, Bangladesh Bureau of Statistics (BBS)

Note : The figure of 2000/01 is preliminary.

Table 2.3.1 Major Natural Disasters Influenced on Bangladesh

Sl. No.	Year	Kind of Disaster	Number of Death	Sl. No.	Year	Kind of Disaster	Number of Death
1	1876	Cyclone	100,000	33	1964	Cyclone	196
2	1885	Flood	ND*	34	1965	Cyclone	19,279
3	1892	Flood	ND*	35	1965	Cyclone	35,000
4	1896-97	Drought	ND*	36	1965	Cyclone	873
5	1897	Earthquake	ND*	37	1966	Cyclone	850
6	1897	Cyclone	ND*	38	1969	Cyclone	75
7	1898	Cyclone	175,000	39	1969	Tornado	922
8	1901	Cyclone	ND*	40	1970	Cyclone	500,000
9	1906-07	Flood	ND*	41	1972	Drought	ND*
10	1909	Cyclone	ND*	42	1973	Cyclone	103
11	1911	Cyclone	ND*	43	1974	Cyclone	4,000
12	1917	Cyclone	ND*	44	1974	Flood and accompanying famine	30,000**
13	1918	Earthquake	ND*	45	1975	Cyclone	5
14	1918	Flood	ND*	46	1975	Flood	ND*
15	1919	Cyclone	ND*	47	1977	Cyclone	ND*
16	1922	Cyclone	ND*	48	1978-79	Drought	ND*
17	1922	Flood	ND*	49	1981	Cyclone	2
18	1923	Cyclone	ND*	50	1982	Drought	ND*
19	1926	Cyclone	ND*	51	1983	Cyclone	343
20	1936	Cyclone	ND*	52	1984	Flood	ND*
21	1941	Cyclone	ND*	53	1984	Cyclone	ND*
22	1942	Cyclone	ND*	54	1985	Cyclone	12,000
23	1943-44	Drought, Downpour	300,000	55	1986	Cyclone	14
24	1947	Earthquake	ND*	56	1987	Flood	1,657
25	1950	Earthquake	ND*	57	1988	Flood	2,379
26	1954	Earthquake	ND*	58	1988	Cyclone	11,069
27	1955	Flood	ND*	59	1989	Drought	ND*
28	1957	Earthquake	ND*	60	1989	Tornado	800
29	1960	Cyclone	3,000	61	1991	Cyclone	138,000
30	1960	Cyclone	5,149	62	1996	Tornado	540
31	1961	Cyclone	11,466	63	1998	Flood	918
32	1963	Cyclone	11,520				

Source : BBS, 1990; Gp. Capt. Syed Ahmed 1986; CDL, 1992a; Kafiluddin, 1991; ADB 1991a; Mahalanobis, 1927, CR of MDMR, Bangladesh Disaster Report 2000, Disaster Forum Bangladesh

Notes

1. ND : Data not available
2. Number of death caused by flood itself in 1974 was 1,987.

Table 2.4.1 Water Level Record of 1988 and 1998 Floods

River	Station	Recorded Maximum WL (m PWD)	Danger Level* (m PWD)	Peak of the Year (m PWD)		Days above Danger Level	
				1988	1998	1988	1998
Dhalia	Kurigram	27.50	26.50	27.25	27.22	16	30
Teesta	Dalia	52.97	52.25	52.89	52.20	8	NA
Teesta	Kaunia	30.52	30.00	30.43	29.91	38	NA
Brahmaputra	Noonkhawa	28.10	27.89	NA	27.35	2	NA
Brahmaputra	Chilmari	25.06	24.00	25.04	24.77	15	22
Jamuna	Bahadurabad	20.62	19.50	20.62	20.37	27	66
Jamuna	Serajganj	15.12	13.75	15.12	14.76	44	48
Jamuna	Aricha	10.58	9.14	10.58	10.76	31	68
Old Brahmaputra	Jamalpur	18.00	17.00	17.83	17.47	8	31
Old Brahmaputra	Mymensingh	14.02	12.50	13.69	13.04	10	33
Buriganga	Dhaka	7.58	6.00	7.58	7.24	23	57
Lakhya	Narayanganj	6.71	5.50	6.71	6.93	36	71
Turag	Mirpur	8.35	5.94	NA	7.97	NA	70
Turag	Tongi	7.84	6.08	NA	7.54	NA	66
Kaliganga	Taraghat	10.39	8.38	10.39	10.21	65	66
Karatoa	Panchagarh	72.65	70.75	70.95	71.08	1	3
Punarbhaba	Dinajpur	34.40	33.50	34.25	34.09	4	3
Mahananda	Chapai Nawabganj	22.25	21.00	21.98	23.01	32	60
Little Jamuna	Naogaon	15.63	15.24	NA	15.48	NA	17
Padma	Pankha	22.97	21.50	NA	24.14	NA	66
Padma	Rajshahi	20.00	18.50	19.18	19.68	24	28
Padma	Hardinge Bridge	15.04	14.25	14.87	15.19	23	27
Padma	Goalundo	9.83	9.83	9.83	10.21	41	68
Padma	Bhagyakul	7.58	7.58	7.43	7.50	47	72
Gorai	Gorai Rly Br	13.65	13.65	13.65	13.45	25	25
Surma	Kanaighat	15.26	13.20	15.10	15.00	75	73
Surma	Sylhet	11.95	11.25	11.95	11.72	21	14
Surma	Sunamganj	9.46	8.25	9.30	8.90	62	56
Kushiyara	Amalshid	18.28	15.85	17.50	17.61	65	54
Kushiyara	Sheola	14.33	13.50	14.09	14.14	80	37
Manu	Manu Rly Br	19.39	17.07	18.95	18.63	66	6
Manu	Moulvi Bazar	13.25	11.75	13.01	11.68	25	NA
Khowai	Habiganj	11.55	9.50	11.00	11.44	14	8
Someswari	Durgapur	15.15	13.00	14.31	13.92	30	7
Upper Meghna	Bhairab Bazar	7.66	6.25	7.66	7.33	68	68
Gumti	Comilla	13.56	11.75	12.79	12.90	17	11
Muhuri	Parshuram	14.85	13.00	12.42	14.60	48	9
Halda	Narayangat	18.25	14.63	NA	16.57	NA	21
Halda	Panchpukuria	11.55	9.50	10.05	10.44	6	4
Sangu	Bandarban	20.38	15.25	16.80	15.25	3	1
Sangu	Dohazari	9.05	7.00	NA	7.42	NA	2
Matamuhuri	Lama	15.45	12.25	12.18	13.05	NA	2
Feni	Ramgarh	21.41	17.37	NA	17.50	NA	1

Source : FFWC

Note : Danger level (D.L.) of each station is defined by BWDB as follows:

- for Non-embanked River : about annual average flood level
- for Embanked River : slightly below design flood level of the embankment

Table 2.4.2 Probability Analysis of Flood Inundation Area in Bangladesh (42 samples from 1954 to 2001)

Order	Flood Area (km^2)	Share in Total Area	Year	Exceedence Probability					Non-exceedence Probability					Return Period (years)					
				Weibull	Hazen	Gringorten	Blom	Cunnane	Weibull	Hazen	Gringorten	Blom	Cunnane	Weibull	Hazen	Gringorten	Blom	Cunnane	Mean
1	100,250	68.2%	1998	0.023	0.012	0.013	0.015	0.014	0.977	0.988	0.987	0.985	0.986	43.48	83.33	76.92	66.67	71.43	68.37
2	89,970	61.2%	1988	0.047	0.036	0.037	0.038	0.038	0.953	0.964	0.963	0.962	0.962	21.28	27.78	27.03	26.32	26.32	25.74
3	57,300	39.0%	1987	0.070	0.060	0.061	0.062	0.062	0.930	0.940	0.939	0.938	0.938	14.29	16.67	16.39	16.13	16.13	15.92
4	52,600	35.8%	1974	0.093	0.083	0.085	0.086	0.085	0.907	0.917	0.915	0.914	0.915	10.75	12.05	11.76	11.63	11.76	11.59
5	50,500	34.4%	1955	0.116	0.107	0.108	0.109	0.109	0.884	0.893	0.892	0.891	0.891	8.62	9.35	9.26	9.17	9.17	9.11
6	43,100	29.3%	1963	0.140	0.131	0.132	0.133	0.133	0.860	0.869	0.868	0.867	0.867	7.14	7.63	7.58	7.52	7.52	7.48
7	42,400	28.8%	1970	0.163	0.155	0.156	0.157	0.156	0.837	0.845	0.844	0.843	0.844	6.13	6.45	6.41	6.37	6.41	6.36
8	41,400	28.2%	1969	0.186	0.179	0.179	0.180	0.180	0.814	0.821	0.821	0.820	0.820	5.38	5.59	5.59	5.56	5.56	5.53
9	37,200	25.3%	1962	0.209	0.202	0.203	0.204	0.204	0.791	0.798	0.797	0.796	0.796	4.78	4.95	4.93	4.90	4.90	4.89
10	37,200	25.3%	1968	0.233	0.226	0.227	0.228	0.227	0.767	0.774	0.773	0.772	0.773	4.29	4.42	4.41	4.39	4.41	4.38
11	36,800	25.0%	1954	0.256	0.250	0.251	0.251	0.251	0.744	0.750	0.749	0.749	0.749	3.91	4.00	3.98	3.98	3.98	3.97
12	36,300	24.7%	1971	0.279	0.274	0.274	0.275	0.275	0.721	0.726	0.726	0.725	0.725	3.58	3.65	3.65	3.64	3.64	3.63
13	35,800	24.4%	1996	0.302	0.298	0.298	0.299	0.299	0.698	0.702	0.702	0.701	0.701	3.31	3.36	3.36	3.34	3.34	3.34
14	35,700	24.3%	2000	0.326	0.321	0.322	0.322	0.322	0.674	0.679	0.678	0.678	0.678	3.07	3.12	3.11	3.11	3.11	3.10
15	35,400	24.1%	1956	0.349	0.345	0.346	0.346	0.346	0.651	0.655	0.654	0.654	0.654	2.87	2.90	2.89	2.89	2.89	2.89
16	33,400	22.7%	1966	0.372	0.369	0.369	0.370	0.370	0.628	0.631	0.631	0.630	0.630	2.69	2.71	2.71	2.70	2.70	2.70
17	33,000	22.4%	1980	0.395	0.393	0.393	0.393	0.393	0.605	0.607	0.607	0.607	0.607	2.53	2.54	2.54	2.54	2.54	2.54
18	32,850	22.3%	1999	0.419	0.417	0.417	0.417	0.417	0.581	0.583	0.583	0.583	0.583	2.39	2.40	2.40	2.40	2.40	2.40
19	32,000	21.8%	1995	0.442	0.440	0.441	0.441	0.441	0.558	0.560	0.559	0.559	0.559	2.26	2.27	2.27	2.27	2.27	2.27
20	31,000	21.1%	1964	0.465	0.464	0.464	0.464	0.464	0.535	0.536	0.536	0.536	0.536	2.15	2.16	2.16	2.16	2.16	2.15
21	29,800	20.3%	1973	0.488	0.488	0.488	0.488	0.488	0.512	0.512	0.512	0.512	0.512	2.05	2.05	2.05	2.05	2.05	2.05
22	28,800	19.6%	1961	0.512	0.512	0.512	0.512	0.512	0.488	0.488	0.488	0.488	0.488	1.95	1.95	1.95	1.95	1.95	1.95
23	28,742	19.6%	1993	0.535	0.536	0.536	0.536	0.536	0.465	0.464	0.464	0.464	0.464	1.87	1.87	1.87	1.87	1.87	1.87
24	28,600	19.5%	1991	0.558	0.560	0.559	0.559	0.559	0.442	0.440	0.441	0.441	0.441	1.79	1.79	1.79	1.79	1.79	1.79
25	28,400	19.3%	1960	0.581	0.583	0.583	0.583	0.583	0.419	0.417	0.417	0.417	0.417	1.72	1.72	1.72	1.72	1.72	1.72
26	28,400	19.3%	1965	0.605	0.607	0.607	0.607	0.607	0.395	0.393	0.393	0.393	0.393	1.65	1.65	1.65	1.65	1.65	1.65
27	28,300	19.3%	1976	0.628	0.631	0.631	0.630	0.630	0.372	0.369	0.369	0.370	0.370	1.59	1.58	1.58	1.59	1.59	1.59
28	28,200	19.2%	1984	0.651	0.655	0.654	0.654	0.654	0.349	0.345	0.346	0.346	0.346	1.54	1.53	1.53	1.53	1.53	1.53
29	25,700	17.5%	1967	0.674	0.679	0.678	0.678	0.678	0.326	0.321	0.322	0.322	0.322	1.48	1.47	1.47	1.47	1.47	1.48
30	20,800	14.1%	1972	0.698	0.702	0.702	0.701	0.701	0.302	0.298	0.298	0.299	0.299	1.43	1.42	1.42	1.43	1.43	1.43
31	16,600	11.3%	1975	0.721	0.726	0.726	0.725	0.725	0.279	0.274	0.274	0.275	0.275	1.39	1.38	1.38	1.38	1.38	1.38
32	12,500	8.5%	1977	0.744	0.750	0.749	0.749	0.749	0.256	0.250	0.251	0.251	0.251	1.34	1.33	1.34	1.34	1.34	1.34
33	11,400	7.8%	1985	0.767	0.774	0.773	0.772	0.773	0.233	0.226	0.227	0.228	0.227	1.30	1.29	1.29	1.30	1.29	1.30
34	11,100	7.6%	1983	0.791	0.798	0.797	0.796	0.796	0.209	0.202	0.203	0.204	0.204	1.26	1.25	1.25	1.26	1.26	1.26
35	10,800	7.3%	1978	0.814	0.821	0.821	0.820	0.820	0.186	0.179	0.179	0.180	0.180	1.23	1.22	1.22	1.22	1.22	1.22
36	6,100	4.1%	1989	0.837	0.845	0.844	0.843	0.844	0.163	0.155	0.156	0.157	0.156	1.19	1.18	1.18	1.19	1.18	1.19
37	4,600	3.1%	1986	0.860	0.869	0.868	0.867	0.867	0.140	0.131	0.132	0.133	0.133	1.16	1.15	1.15	1.15	1.15	1.15
38	4,000	2.7%	2001	0.884	0.893	0.892	0.891	0.891	0.116	0.107	0.108	0.109	0.109	1.13	1.12	1.12	1.12	1.12	1.12
39	3,500	2.4%	1990	0.907	0.917	0.915	0.914	0.915	0.093	0.083	0.085	0.086	0.085	1.10	1.09	1.09	1.09	1.09	1.09
40	3,140	2.1%	1982	0.930	0.940	0.939	0.938	0.938	0.070	0.060	0.061	0.062	0.062	1.08	1.06	1.06	1.07	1.07	1.07
41	2,000	1.4%	1992	0.953	0.964	0.963	0.962	0.962	0.047	0.036	0.037	0.038	0.038	1.05	1.04	1.04	1.04	1.04	1.04
42	419	0.3%	1994	0.977	0.988	0.987	0.985	0.986	0.023	0.012	0.013	0.015	0.014	1.02	1.01	1.01	1.02	1.01	1.02

Return Period (Years)	1.10	1.25	1.5	2	5	10	25	50	100
Flood Area (km^2)	5,400	9,500	25,500	30,000	39,900	49,100	89,500	97,400	103,700
Share in Total Area	3.7%	6.5%	17.3%	20.4%	27.1%	33.4%	60.9%	66.3%	70.5%

Table 2.4.3 River Cross Sections Surveyed by BWDB

No.	River Name	Number of Sections	Interval (km)	Length (km)	Frequency
1	Brahmaputra-Jamuna	39	6.44	266	Yearly
2	Ganges	21	6.44	133	Yearly
3	Padma	15	6.44	105	Yearly
4	Meghna	45	6.44	254	Yearly
5	Meghna Lower	12	6.44	71	Yearly
6	Gorai-Madhamati	42	6.44	272	Yearly
7	Buriganga	8	6.44	45	2-yearly
8	Dhaleswari	23	6.44	145	2-yearly
9	Surma	42	6.44	266	2-yearly
10	Mohananda	14	6.44	89	2-yearly
11	Arial Khan	32	6.44	189	2-yearly
12	Old Brahmaputra	36	6.44	113	3-yearly
13	Bangshi	26	6.44	161	3-yearly
14	Lakhya	19	6.44	113	3-yearly
15	Kaliganga	10	6.44	58	3-yearly
16	Bibiyana	9	6.44	52	3-yearly
17	Kushiyara	16	6.44	97	3-yearly
18	Turag	12	6.44	71	3-yearly
19	Banar	26	6.44	161	3-yearly
20	Naya Surma	27	6.44	130	3-yearly
21	Matamuhuri	17	6.44	103	3-yearly
22	Muhuri	7	6.44	39	3-yearly
23	Manu	8	6.44	45	3-yearly
24	Feni	13	6.44	84	3-yearly
25	Gumti	23	6.44	142	3-yearly
26	Dakatia	18	6.44	106	3-yearly
27	Bhogai-Kangs	22	6.44	137	3-yearly
28	Sumeswari	16	6.44	97	3-yearly
29	Khowai	12	6.44	71	3-yearly
30	Barak	6	6.44	26	3-yearly
31	Teesta	20	6.44	122	3-yearly
32	Baral-Gumani	38	6.44	292	3-yearly
33	Betna	17	6.44	117	3-yearly
34	Biskhali	18	6.44	84	3-yearly
35	Bhairab	34	6.44	210	3-yearly
36	Dharala	15	6.44	94	3-yearly
37	Tulshiganga	27	6.44	168	3-yearly
38	Chitra	32	6.44	170	3-yearly
39	Kobadak	35	6.44	235	3-yearly
40	Korotoa-Atrai-Gumaoi	45	6.44	292	3-yearly
41	Hariher-Bhadra	13	6.44	85	3-yearly
42	Hurasagar-Karatoa	21	6.44	128	3-yearly
43	Rupsha-Pasur	13	6.44	80	3-yearly
44	Nobaganga	8	6.44	45	3-yearly
45	Kumar	36	6.44	210	3-yearly
46	Jamunaswari-Karatoa	32	6.44	208	3-yearly
47	Bangali	30	6.44	195	3-yearly
	Total	1,050		6,376	

Source: BWDB

Table 2.5.1 FAP Components

FAP No.	Activities	Funding Source	Amount in 10^6 US$ equivalent
	Main Components (11 Components)		
1	Brahmaputra Right Embankment Strengthening	IDA	3.36
2	Northwest Regional Study	UK, Japan	4.60
3	North Central Regional Study	EU, France	3.56
3-1	Jamalpur Priority Project	France, EU	2.85
4	Southwest Area Study	UUDP,ADB	3.83
5	Southeast Regional Study	UNDP	2.20
6	Northeast Regional Study	Canada	14.6
7	Cyclone Protection Project	EU,IDA	1.00
8A	Greater Dhaka Protection Project	Japan	3.00
8B	Dhaka Integrated Flood Protection Project	ADB	0.57
9A	Secondary Town Integrated Protection Project	ADB	0.55
9B	Meghna River Bank Protection Project	IDA	1.15
10	Flood Forecasting and Warning Expansion	UNDP, Japan	5.70
11	Disaster Preparedness Project	UNDP, Japan, Denmark	1.10
	Supporting Studies (15 Studies)		
12	FCD/1 Review	UK, Japan	1.60
13	Operation and Maintenance Study	UK, Japan	0.60
14	Flood Response Study	USA	0.32
15	Land Acquisition and Resettlement Study	Sweden	0.40
16	Environmental Study	USA	4.04
17	Fisheries Study and Pilot Project	UK	3.40
18	Topographic Mapping	Finland, France, Switzerland	6.71
19	Geographic Information System	USA	4.36
20	Compartmentalization Pilot Project	Netherlands, Germany	17.09
21/22	Bank Protection, River Training and Active Flood Control Management	Germany, France	40.00
23	Flood Proofing Pilot Project	USA	0.30
24	River Survey Program	EU	14.70
25	Flood Modeling and Management	Denmark, France, Netherlands, UK	4.39
26	Institutional Development Program	UNDP, France	3.60
	Macro-economic Study (Special Study)	France	0.41

Table 2.5.2 Brief Features of the Completed and On-going Projects (1/2)

	1	2	3	4	5	6	7	8	9	10	11	12	13
Name of Project	**Jamuna River Bank Protection Project**	**Ganges Kobadak Irrigation Project (GK Irrigation Project)**	**Khulna-Jessore Drainage Rehabilitation Project**	**Char Development and Settlement Project-II**	**Meghna-Dhonagoda Irrigation Project**	**Command Area Development Project**	**Teesta Barrage Project Phase-1**	**Chandpur Irrigation Project**	**Compartmentalization Pilot Project (CPP)**	**Coastal Embankment Rehabilitation Project**	**Briganga River Bank Protection and Development Project (Right Bank)**	**Amirpur-Vandercot-Baliadanga Project**	**River Bank Protection Project (Brahmaputra)**
Type of Project	Preventing merger of Jamuna and Bangali rivers	Supplemental Irrigation	Poverty reduction by agricultural production	Improvement of socio-economic conditions	Flood control, Drainage, Irrigation	Sustainable increase in winter dry season agri.production	Increase of agricultural production	Flood control, drainage and irrigation	Agricultural development	Rehabilitation of embankment	Flood control/ resettlement of illegal settlers / ecological protection	Multisectral project including flood control and socio-economic development	Bank protection work in the Brahmaputra River)
Location	Jamuna West bank, Sariakandi / Sirajganj :NW Region	Right bank of Ganges, D/S Hardinge Bridge: (SW Region)	South-western Region (SW Region)	Noakhali, Luxmipur,Feni and Chittagong (NE Region)	Chandpur facing Jamuna & Dhonagoda River (NW Region)	Pabna IRDP / MDIP Projects facing to Jamuna, Padoma and Meghna (NE & NW	Upstream Teesta River a tributary of Jamuna (NW Region)	Chandpur, Laxmipur Districts facing left bank of Meghna, & Dakatia R (NE Region)	Tangail District facing left bank of Jamuna R.	Several hundred km along the coastal line	Dhaka City (Central zone)	South-east side of Khulna city bounded by the Vairab, Rupsha, Kazibasa and Pshbur	Sariakandi & Sirajganj Sadar, Bogra & Sirajganj Districts
District / Upa-zilla	Sariakandi / Sirajganj	Kushtia, Chuadanga, Zinaidha, Magura	Jessore and Khulna	Six upazillas	15 Unions of Upazilla Matlab, Chandpur		Teesta, Atrai, Shantahar-Bogra, Bogra-Kaunia	3 upzilla in Chandpur, 3Upazilla in Laxmipur	4upazilla, Tangail	21 coastal polders	Dhaka City	Khula City	
Major objectives	Flood Control	Irrigation	Drainage improv't	Char Development and Settlement	Irrigation	Upgrading of command areas of past irrigation projects	Irrigation	Irrigation	Agricultural development	Erosion control, agricultural &forestry development		Flood control/ prevent salinity/ drainage/ socio-economic development	To prevent merger of the Brahmaputra and Bangali rivers, to protect Sirajgani town
Implementing agency	BWDB	BWDB	BWDB	BWDB	BWDB	BWDB	BWDB	BWDB	BWDB	BWDB	BWDB	BWDB	BWDB
Existing structure	Bank protection 220km												
Beneficial		2million	800,000									9500	175,500
Project features													
	Project-1	Project area:197,500ha	Project area:100,600ha	Project area:88,000ha	Project area:17,584ha	**Pabna Irrigation & Rural Development Project**	Command area:750,000ha (Phase-1 :154,250ha)	Project area:53,363ha	Project area:13,305ha	Project area:240,000ha	Protection from illegal settlers:	Embankment 52km	Concrete block: About 2,583,000 pieces
	Location: Sariakandi	Irrigable area: 142,000ha	Culyivable area 78,000ha	**BWDB Part**	Irrigation area:13,602ha	Project area:184,000ha area:184,000ha	Irrigable area:540,000ha (Phase-1:111,406ha)	Irrigable area:28,423ha	Cultivable area:9,858ha	House holds: 200,000 Population:1.2million	River side protection: 7.748km	Nolua river closer with several sector works	Geotextile: 451705 m2
	Component-1	Pump house-2 nos	River dredging:30km	Flood embankment:32.3km	Pump station:4units	Irrigation area:18,870ha	Barrage:1no. L=615m	Pum house: 6pumps 5,67m3/s each	Embankment:60km	Embankment: 570km (Existing)	Bridges:15nos Culverts: 2nos Small structures: 5nos	Gross area of 7,330ha	Dredging: 6,809,738 m3
	Groin	Main Pumps: 3units 36.83cfs each	drainage channel:555km	Drainage Channel:164km	Flood embankment:60km	Flood embankment:25km	Head regulator:1no. L=110m	Regulator with navigation lock:1no	Canal:96km	Sluice:300nos (Existing)	Environment deve. Forestation / bench/ 5.32km	Cultivable area of 5,600ha	
	Revetment 111m	Subsidiary pumps: 12units 3.54cfs each	River cloure:1no.	Irrigation Channel:4.9km	Drainage channel:125.5km	Protection :3.72km	Closure dam:1no. L=2,470m	Regulators:4nos	Intake:15nos	Rehabilitation of embankment:120km	Road: 7.748km River digging: 0.189km3		
	Shank 134m	Discharge: 153cfs	Outlet:21nos.	Drainage Sluice:10n0s	Irrigation canal:218km	Irrigation canal:256km	Flood by-pass:1no. L=610m	Flood embankment:100km	Outlet:17nos	Rehabikitaion of slope protection:10km	Others: LS		
	Component-2	Main canal 193km	Embankment:33km	Irrigation inlets:2nos	Main canal:34km	Drainage channel:50km	Silt trap:1no.	main irrigation canal:58km	Control:37nos	Rehabilitation of sluice:41nos			
	Hard point, Mathurapara	Secandary canal 467km	Access road:111km	Access road:8.4km	Secondary canal:64km	Pump st.:2 stations repair	Flood embankment:80km	Secondary canal:754km	Bridge / culvert:25nos				
	Revetment 661m	Tertiary cnal 995km	River bank	Culvert:21nos	Tertiary canal:120km		Main canal:34km	LLP:1,600nos	Groyne:2nos				
	Cross-bar 935m	Drainage canal 971 km	Regulator:7nos	**LGED Part**	Regulator:69nos		Secondary canal:L=290km						
	Component-3	Pump house-2 units	Culvert / Bridges:38nos	Rural road:58.37km	Irrigation Conduit:14nos		Tertiary canal:L=325.24km						
	Hardpont, Link	Flood control emb.39km	Foot bridges:30nos	Bridge and culvert:34nos	Drainage conduit:39nos	**Meghna-Dhonagoda Irrigation Projects**	Drainage canal:L=250km						
	Revetment 679m	hydraulic structure]:2184	Pipe outlet:2nos	Cyclone shelter:27 nos	Chech gate:42nos	Project area:17,584ha	Irrigation str.:1,110nos						
	Cross-bar 420m	Inspection road: 228km		Domestic pund:47nos	Combined	Irrigation area:13,602ha	Drainage str.:50nos						
	Component-4	Outlet:3500nos		DPHE Part	Sescape:17nos	Flood embankment:38km	Turn out:2,000nos						
	Embankment 6km	Electlicity: 14mw		Deep tube well:27nos	Aquiduct:3nos	Protection :42km	Inspection road:100km						
	Project-2	Dredger: 18"*2nos, 12"*2nos		Sanitary latrine:2,864nos	Drainage outlet:9nos	Irrigation canal:183km							
	Location: Siraiganj			**DAE Part**	Bridge:72nos	Drainage channel:47km							
	Component			On-farmresearch	Turn-out:744nos	Pump st.:2 stations							
	River training 2.55km			Demonstration plot									
				Training									
				afforestation									
				MoL Part									
				Settlement:3,224hh									

Table 2.5.2 Brief Features of the Completed and On-going Projects (2/2)

	1	2	3	4	5	6	7	8	9	10	11	12	13
Name of Project	**Jamuna River Bank Protection Project**	**Ganges Kobadak Irrigation Project (GK Irrigation Project)**	**Khulna-Jessore Drainage Rehabilitation Project**	**Char Development and Settlement Project-II**	**Meghna-Dhonagoda Irrigation Project**	**Command Area Development Project**	**Teesta Barrage Project Phase-1**	**Chandpur Irrigation Project**	**Compartmentalization Pilot Project (CPP)**	**Coastal Embankment Rehabilitation Project**	**Briganga River Bank Protection and Development Project (Right Bank)**	**Amirpur-Vandercot-Baliadanga Project**	**River Bank Protection Project (Brahmaputra)**
Implementation and O&M													
Const. Period	May-96/Dec-2001	1955/56-1982/83	1986/Dec.2002	1999/2000-2003/2004	1979/80-1987/88	Imple. 1996.97-2002/03	1960-1998	1963-1978	1991/92-1999/2000		2001/02-2004/05	1998/98-2000/01	1996-2001
Construction stages		2 Stages(1st:55-70/2nd:60-83)				On-going	Barrage constr.1979-1998				On-going	Completed	Completed
Const. Cost(mil. Taka)	7,533.10	738.9	2,572.40	1,278.2	1,750.3		9,695.29	543.0	1,172.60	5,000	663.093	190.525	7,533.10
	F:5,290.8 / L2,242.30			F:2,93.1 / L:985.1	F:482.8 / L1,267.6			F:171.5 / L37.15					GOB:2,242.3 IDA:5,290.8
Rehabilitation (mil. Taka)		2125.6											
Annual OM Cost(mil.Tk)		290			46.3			50.0	9.2				
Financing	IDA, GOB		ADB, GOB	GON, WFP, GOB	ADB, GOB		SFD, IDB, AFD, GOB	IDA, GOB	Netherlands, German, GOB				
Consultant	S.W.Halcrow / EPC		SMEC		Chu0-Kaihatu / Prakaushali Sagsad		Local consultants						Sir William Halcrow & Partners (UK) and Engineering and Planning Consultant (B)
Contractor	Hyundai / Jan De Nul /Local						Local contractors						Hyundai-Jan De Nul JV
Annual income(mil.Taka)								2000.0	156.0				NA
Cropping intensity								151%→234%	191%→264%				NA
Present situation							Upgrading Phase-1 project under thisProject	Implementation of erosion protection					
Consideration													
Present condition	Design flood: 100yr with free board of 1.5m	Completed but so much OM for dredging (30-40 thausand m3/y)	Special pilot project for river maintenance and land reclamation in Beel	Small island created by delta development	Completed but needs heavy bank erosion protection	New project for further development of the completed project	Completed big irrigation project	Completed	Large scale Compartmentalization project	Completed, but need heavy rehabilitation work of bank protection		Current progress 10%	
Problem	Serious erosion	Pump rehabiiitation is required	Completed but need embankment rehabiiitation	Suffered by Cyclone, and huge rehabilitation needed	Not stable land area due to erosion, and costly protection work	Agricultural production increase is remarkable, but maintenance is	Water coming from India is uncertain in dry season.	Huge rehabilitation work needed	will bring another problem on flood concentration	Not stable land area due to erosion	Many illegal establishment and dockyards	Very poor people due to hindrance of production	
	Heavy maintenance work	Not active performance	Monitoring essential	Affected by Cyclone	Costly drainage pump operation	Serious bank erosion	Huge sedimentation	Subject to heavy erosion		Huge sedimentation and erosion		Lack of fund	
Conceivable Solution & necessary actions	There would be dangerous case of bank breaching	Waiting for pump replacement fund	Theoretical approach needed. Special fund is to be considered	Social & Economical viability be studied	River morphology study and detailed environmental study be	Geo-textile slope protection is doubtful.	International agreement of water allocation is essential	River morphological study including deltaic development study	Overall water resources development and flood control study are needed	River morphological study including deltaic development study		Feasibility study should be conducted for looking for financial source	
	FFWS shall be provided	Flood control works are essential	Very interested delta development process		Costly OM for pump station operation	Monitoring is needed for bank protection	FFWS should be provided						