# SUPPORTING REPORT K

# IMPREMENTATION PROGRAM

# SUPPORTING REPORT K
# IMPLEMENTATION PROGRAM

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# SUPPORTING REPORT K: IMPLEMENTATION PROGRAM

## 1. Basic Concept

The implementation program of the project is formulated taking into account the following aspects:

1) Potential realization of quick benefits by strengthening or rehabilitation of the existing flood mitigation facilities as much as possible.

2) Development trends, population increase, and land use patterns are considered in determining the sequence of project priority.

3) The scale of financial costs and disbursements are considered in determining the implementation program.

4) Consistency with other on-going or proposed programs such as FAP8B and other FAP projects is ensured.

## 2. Project Components

### 2.1 Project Areas

The study area is divided into five(5) sub areas based on river alignments and embankments. However the project area for structural flood mitigation measures is divided into eight(8) divisions for implementation of the project (ref. Fig K.1). These eight(8) divisions are as follows:

1) Greater Dhaka Area

   (1) Dhaka West Project Area
   (2) Dhaka East Project Area

2) Narayanganj Area

   (1) DND Project Area
   (2) Narayanganj West Project Area
   (3) Narayanganj East Project Area

3) Tongi Area

(1) Tongi Project Area

4) Savar Area

(1) Savar Project Area

5) Keraniganj Area

(1) Keraniganj Project Area

The characteristics in terms of socio-economic aspects, flood damage, existing facilities etc. are described below:

1) Greater Dhaka Area

Most of Greater Dhaka, with an area of 263 $km^2$, is protected by embankment.

The Greater Dhaka Area is divided into two project areas, Dhaka West and Dhaka East.

(1) Dhaka West Project Area

The Dhaka West area covers an area of 139 $km^2$ with an estimated population of 6.1 million in 2010. This area includes Kamrangir Char and the western part of the Greater Dhaka, where most flood mitigation facilities have already been completed.

In this area however, rehabilitation work for some portions of embankment is necessary due to failure and settlement of the constructed embankment.

The construction of flood wall type structures is urgently required for the reach from Kellar More to Mitford Hospital in order to securely complete the previous project being carried out by the Government under its Phase I programme.

Stormwater drainage projects, including the construction of a pump station and the improvement of khals, are being carried out in the Kalayanpur drainage zone and the Dholai Khal zone.

The northern parts of this area have been rapidly developed since the embankment was constructed.

(2) Dhaka East Project Area

The Dhaka East area covers an area of 124 $km^2$ with an estimated population of 2.3 million in 2010. It includes the whole eastern part located between Tongi to Syedabad Road and the Balu river of Greater Dhaka.

A development scheme has been planned by RAJUK in the northern higher land and some residential land development has been carried out by the private sector in the southern low-lying areas.

This project area comprises a portion of the Phase II works previously proposed by the Government.

Some land acquisition procedure has already been accomplished for the proposed embankment along the Balu river. However, it was suspended due to some local problems. No major facilities have so far been constructed.

2) Narayanganj Area

The Narayanganj area is divided into three(3) project areas, the DND Project area, Narayanganj West area that includes the industrial zone, and Narayanganj East area to the eastern side of the Lhakya river.

(3) DND Project Area

The DND project area covers an area of 57 $km^2$ with an estimated population of 1.3 million in 2010.

This area has been protected from both external and internal floods by a road-cum-embankment and pump station, installed under the DND Irrigation Project. Furthermore, after the 1988 flood, flood walls along the road-cum-embankment were constructed, thereby enhancing the safety against flooding.

Due to this, the area has been rapidly developed as a residential area since the 1988 flood.

(4) Narayanganj West Project Area

The Narayanganj West area covers an area of 19 $km^2$ with an estimated population of 927,000 in 2010. This area includes the mostly urbanized area of Narayanganj and the industrial area along the Lhakya River. However, 11 $km^2$ of the Southern area is planned as flood plain area.

There is no major flood mitigation or stormwater drainage facility in this area.

(5) Narayanganj East Project Area

The Narayanganj East area covers an area of 13 $km^2$ with an estimated population of 266,000 in 2010.

On the eastern periphery, there in an abandoned railway track which was used as a makeshift evacuation area during the 1988 flood.

The riverside has been developed for ship building-cargo transportation industries, etc. In this area, there is no major flood mitigation and stormwater drainage facility.

3) Tongi Area

The whole Tongi Area is designated as Tongi Project area for structural flood mitigation measures.

(6) Tongi Project Area

The area covers 24 $km^2$, including most of Tongi municipality with an estimated population of 653,000 in 2010.

This area has been developed as an industrial area and has high potential for future development due to its favorable topographic condition. There is no major flood mitigation and stormwater drainage facility in this area.

4) Savar Area

A portion of Savar Area is assigned as one single Savar Project Area for flood mitigation.

(7) Savar Project Area

The area to be protected by the proposed embankment is approximately 21 $km^2$ and the population in 2010 is estimated about 270,000 people. The drainage planning area is about 57 $km^2$.

The northern part consists of relatively high land, composed of the Cantonment and agricultural land. Most portions of the project area were flood free, naturally, during the 1988 flood. However, the central part was seriously affected by this flood. There exists no major flood mitigation and stormwater drainage facility in this area.

5) Keraniganj Area

A portion of Keraniganj fronting the Buriganga River is designated as one single project area for structural flood mitigation measures.

(8) Keraniganj Project Area

This project area covers 24 $km^2$ with an estimated population of 457,000 in 2010. The whole area covers 164 $km^2$ with an estimated population of 813,000 in 2010.

Most of this area is low-lying and is used as agricultural land except the northern portion adjacent to the Buriganga River which is densely populated. With the construction of the Buriganga Bridge, the land development potential of this area has increased recently. Another bridge and a port project are also planned within this project area. There is no major flood mitigation and stormwater drainage facility in this area.

## 2.2 Proposed Facilities

The proposed facilities for flood mitigation and stormwater drainage in each of the eight(8) project areas are summarized, with reference to Supporting Reports G and H.

The list of the proposed facilities is shown in Table K.1, while the location of the facilities is shown in Fig. K.2. to Fig. K.4.

## 2.3. Project Costs

The project costs, which include construction, land acquisition, administration costs, engineering services, and contingency, are estimated in Supporting Report J.

The results are summarized below:

| | | For Structural | For Non-Structural |
|---|---|---|---|
| 1) | Greater Dhaka-West | : 10,682.4 | - |
| | (Previous/on-going Project) | : (3,351.2) | - |
| 2) | Greater Dhaka-East | : 22,296.4 | - |
| | (Previous/on-going Project) | : (226.1) | |
| 3) | DND Area | : 7,527.9 | - |
| | (Previous Project) | (138.5) | - |
| 4) | Narayanganj-West | : 2,992.2 | 40.3 |
| 5) | Narayanganj-East | : 3,630.1 | - |
| 6) | Tongi | : 3,994.5 | 74.9 |
| 7) | Savar | : 2,213.9 | 512.5 |
| 8) | Keraniganj | : 6,325.0 | 918.0 |
| | Total Million Tk. | 59,662.4<br>(3,915.8) | 1,545.7 |

## 3. Phased Implementation Program

### 3.1 Planning Policy

The phased program is formulated taking into account the following policies:

1) The whole project shall be divided into three(3) phased programs with due consideration of the five year construction of each stage plan, and be implemented within the target year of the master plan 2010.

2) The program shall meet the needs of population increase in the concerned development area.

3) Each project is to be carried out in conformity with an appropriate scale of financial disbursement.

4) The projects shall be in consistent with other on-going, proposed project or plans.

## 3.2 Phased Implementation Program

### 3.2.1 Priority of Project Areas and Facility

Priority is based on location and facility. The locational priority is divided into three (3) grades i.e. A, B and C. Priority for each project area was determined as follows in accordance with the results of projects evaluation :

| | Project Area | | Priority |
|---|---|---|---|
| 1. | Greater Dhaka | | |
| | 1) G. Dhaka-West | : | A |
| | 2) G. Dhaka-East | : | A |
| 2. | Narayanganj | | |
| | 1) DND | : | A |
| | 2) N-West | : | A |
| | 3) N-East | : | C |
| 3. | Tongi | : | B |
| 4. | Savar | : | C |
| 5. | Keraniganj | : | B |

### 3.2.2 Phased Implementation Program

The program consisting of three (3) phases is proposed with due consideration of the priority categories and FAP 8B's proposals for Greater Dhaka-west project which are scheduled to start in 1992.

The outline of the phased implementation program is described below :

1 Pre-phase I (1992-1994)
Rehabilitation of the existing flood mitigation facilities and construction of the remaining works which are composed of embankment, flood wall are implemented.

- Preparation of detailed design and project implementation for the proposed works in the phase I of Greater Dhaka-East (GDE), Narayanganj DND and Narayanganj West (N.WEST).

2 Starting in Phase I (1995 ~ 1999)

Greater Dhaka- East, Narayanganj DND area and Narayanganj West area projects are to be implemented in this Phase. For Greater Dhaka-East project, the flood mitigation facilities, which are composed of embankment and sluice gates, are completed during the Phase I.and II

The construction of stormwater drainage facilities, composed of pump stations and khal improvement, will be started and will continue through Phase III (2005~2009). The installation of pumping capacity is determined according to the amount and nature of development in the area.

For the Narayanganj DND area ,Narayanganj West, flood mitigation facilities i.e. embankment and flood wall and some rehabilitation work of the existing flood wall (DND Area), is implemented and completed in this Phase. The stormwater drainage facilities are to be implemented during Phase I and to be completed within Phase II (2000 ~ 2004).

3 Starting in Phase II (2000 ~ 2004)

For Keraniganj and Tongi projects, both the flood mitigation facilities are completed in this Phase II, however stormwater drainage facilities to be completed in the Phase II.and Phase III according to the development condition .

4 Starting in phase III (2005 ~ 2009)

Savar and Narayanganj East Projects are to be implemented and completed in Phase III.

The bar chart of the phased implementation program is shown in Table K.2.

## 4. Priority Project for the Feasibility Study

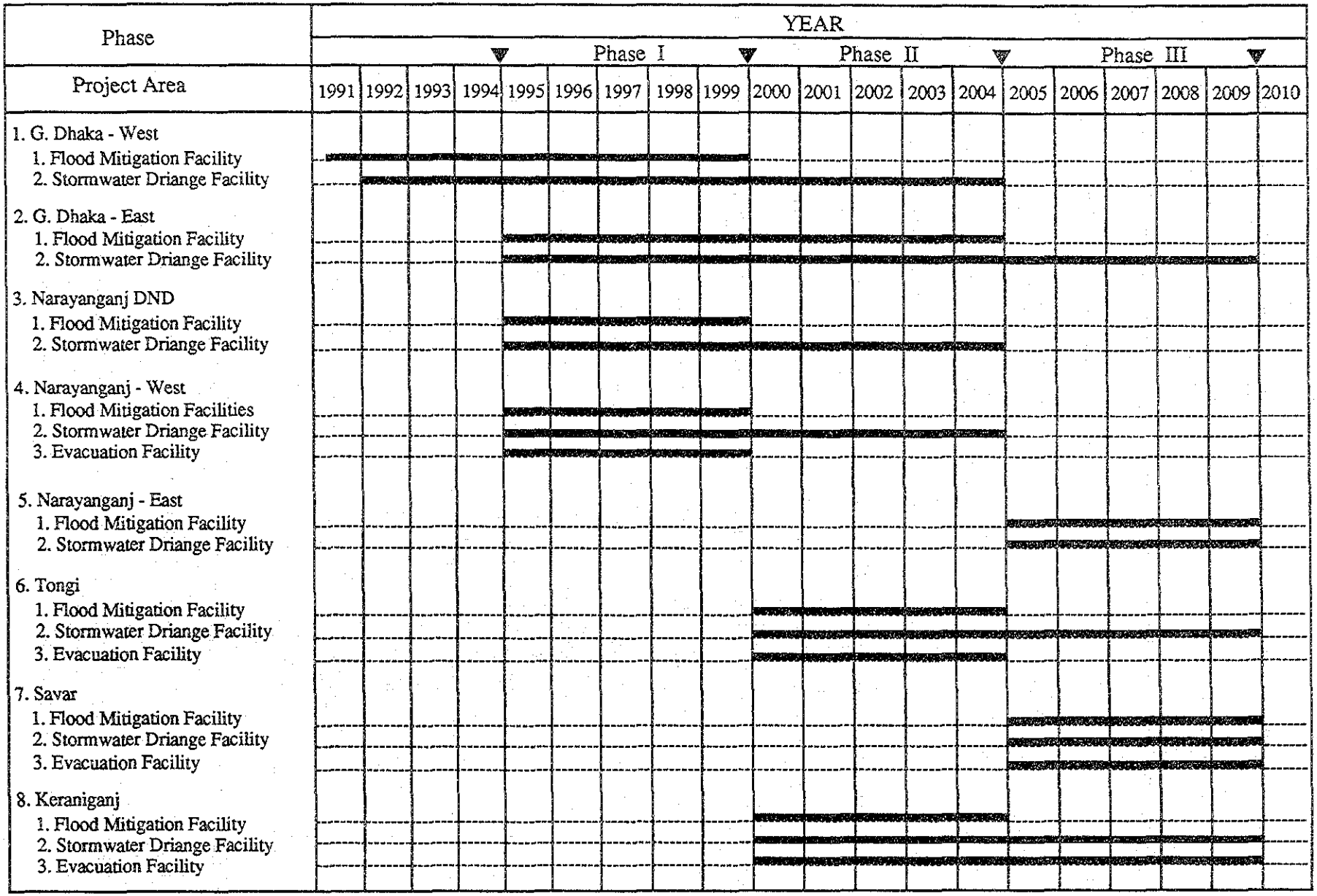
The Dhaka East and DND area,and Narayanganj West projects are selected for feasibility study because of their high priority.

**Table K.1 List of Proposed Facilities**

| Area | Flood Mitigation | | | Stormwater Drainage | | |
|---|---|---|---|---|---|---|
| 1. Greater Dhaka | | | | | | |
| 1) West | a) Embankment (R) | : | 16.7 km | a) Pump Station (No.) | : | 73.2 m3/s (2plcs) |
| | b) Flood wall (R) | : | 4.7 km | b) Khal Improvement | : | 42.7 km |
| | c) Embankment | : | 6.3 km | c) Drainage Pipe | : | 8.1 km |
| | d) Flood Wall | : | 3.0 km | d) Retarding Pond | : | 770.0 ha |
| | e) Sluice Gate | : | 11 plcs | e) Land Acquisition | : | 43.7 ha |
| | f) Land Acquisition | : | 37.0 ha | | | |
| 2) East | a) Embankment | : | 26.7 km | a) Pump Station (No.) | : | 179.1 m3/s (3plcs) |
| | b) Sub Embankment | : | 11.3 km | b) Khal Improvement | : | 72.4 km |
| | c) Sluice Gate | : | 5 plcs | c) Drainage pipe | : | 8.9 km |
| | d) Land Acquisition | : | 317.4 ha | d) Retarding Pond | : | 1,884.0 ha |
| | | | | e) Land Acquisition | : | 168.0 ha |
| 2.Narayanganj | | | | | | |
| 1)DND Area | a) Flood Wall (R) | : | 20.2 km | a) Pump Station (No.) | : | 50.2 m3/s (1plcs) |
| | b) Flood Wall | : | 10.0 km | b) Khal Improvement | : | 38.0 km |
| | c) Sluice Gate | : | 2 plcs | c) Retarding Pond | : | 681.0ha |
| | d) Land Acquisition | : | 5.8 ha | d) Land Acquisition | : | 90.8 ha |
| 2) West | a) Embankment | : | 6.1 km | a) Pump Station (No.) | : | 16.2 m3/s (3plcs) |
| | b) Road-Cum-Embankment | : | 4.3 km | b) Khal Improvement | : | 6.4 km |
| | c) Flood Wall | : | 10.5 km | c) Retarding Pond | : | 170.0 ha |
| | d) Sluice Gate | : | 7 plcs | d) Land Acquisition | : | 12.2 ha |
| | c) Land Acuqisition | : | 61.5 ha | | | |
| | % Evacuation Facilities | | 1 L.S | | | |
| 3) East | a) Embankment | : | 6.6 km | a) Pump Station (No.) | : | 12.5 m3/s (4plcs) |
| | b) Road-Cum-Embankment | : | 6.5 km | b) Khal Improvement | : | 7.4 km |
| | c) Flood Wall | : | 26.0 km | c) Retarding Pond | : | 130.0 ha |
| | d) Sluice Gate | : | 12 plcs | d) Land Acquisition | : | 14.1 ha |
| | e) Land Acquisition | : | 99.2 ha | | | |
| 3. Tongi | a) Embankment | : | 13.0 km | a) Pump Station (No.) | : | 25.2 m3/s (2plcs) |
| | b) Road-Cum-Embankment | : | 6.2 km | b) Khal Improvement | : | 22.0km |
| | c) Flood Wall | : | 2.2 km | c) Retarding Pond | : | 265.0 ha |
| | d) Sluice Gate | : | 7 plcs | d) Land Acquisition | : | 42.5 ha |
| | e) Land Acquisition | : | 100.9 ha | | | |
| | % Evacuation Facilities | : | 1 L.S | | | |
| 4.Savar | a) Embankment | : | 9.3 km | a) Khal Improvement | : | 30.0 km |
| | b) Sluice Gate | : | 3 plcs | b) Land Acquisition | : | 66.2 ha |
| | c) Land Acquisition | : | 62.3 ha | | | |
| | % Evacuation Facilities | : | 1 L.S | | | |
| 5. Keraniganj | a) Embankment | : | 23.3 km | a) Pump Station (No.) | : | 27.7 m3/s (1plcs) |
| | b) Flood Wall | : | 3.7 km | b) Khal Improvement | : | 22.5 km |
| | c) Sluice Gate | : | 10 plcs | c) Retarding Pond | : | 292.0 ha |
| | d) Land Acquisition | : | 163.7 ha | d) Land Acquisition | : | 50.6 ha |
| | % Evacuation Facilities | : | 1 L.S | | | |

Note : 1) Embankment (R) : Rehabilitation Work of Embankment
2) Flood Wall (R) : Rehabilitation Work of Flood Wall
3) Land Acquisition : Retarding Pond is not included
4) Pump station (No.) : Total Capacity (Number of Pump Station)
5) On-Going Projects by JICA and IBRD are not included.

## Table K.2 Phased Implementation Program



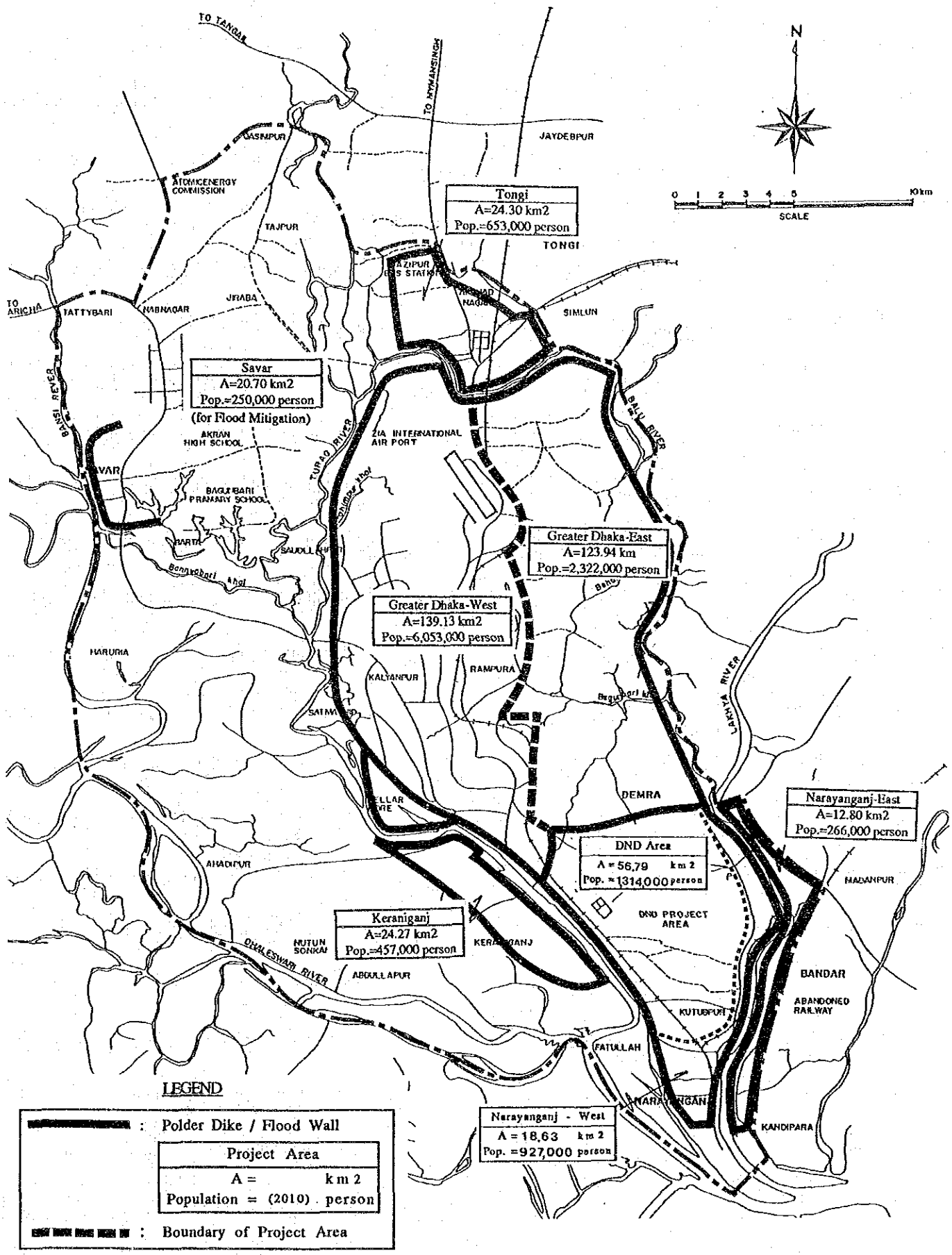
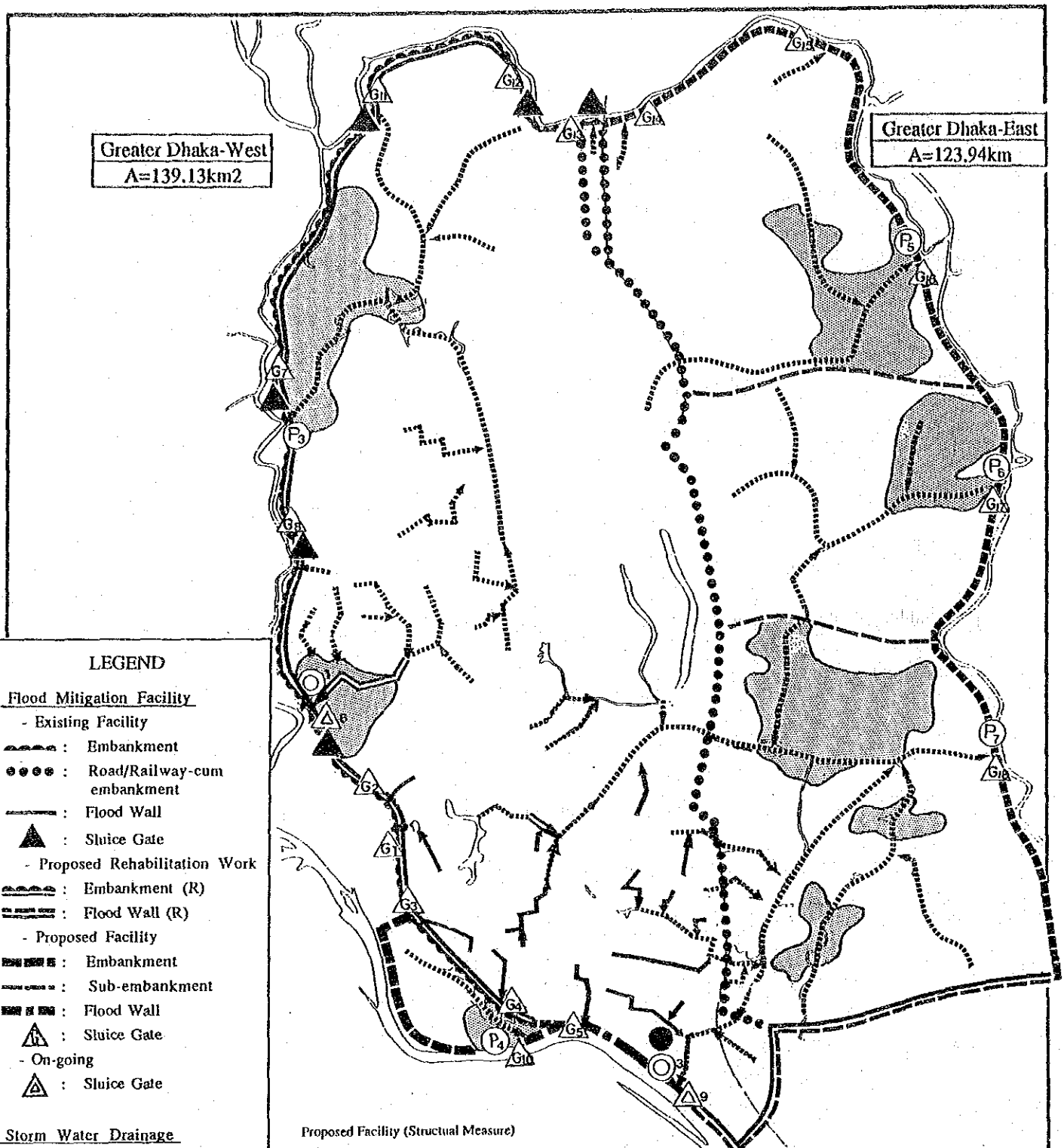



**FIG. K.1** PROJECT AREAS WITH POPULATION (2010)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



JICA




Proposed Facility (Structual Measure)

| Facility | Unit | Greater Dhaka West | Greater Dhaka East |
|---|---|---|---|
| -Flood Mitigation | | | |
| 1. Embankment (R) | Km | 16.7 | - |
| 2. Flood Wall (R) | Km | 4.7 | - |
| 3. Embankment | Km | 6.3 | 26.7 |
| 4. Sub Embankment | Km | - | 11.3 |
| 5. Road-Cum-Embankment | Km | - | - |
| 6. Flood Wall | Km | 3.0 | - |
| 7. Sluice Gate | plcs ($m^2$) | 11 (162.8) | 5 (199.5) |
| 8. Land Acquisition | ha | 37.0 | 317.4 |
| - Storm Water Drainage | | | |
| 1. Pump station | plcs ($m^3/s$) | 2 (73.2) | 3 (179.1) |
| 2. Khal Improvement | Km | 42.7 | 72.4 |
| 3. Drainage Pipe | Km | 8.1 | 8.9 |
| 4. Retarding Pond | ha | 770.0 | 1,884.0 |
| 5. Land Acqisition | ha | 43.7 | 168.0 |

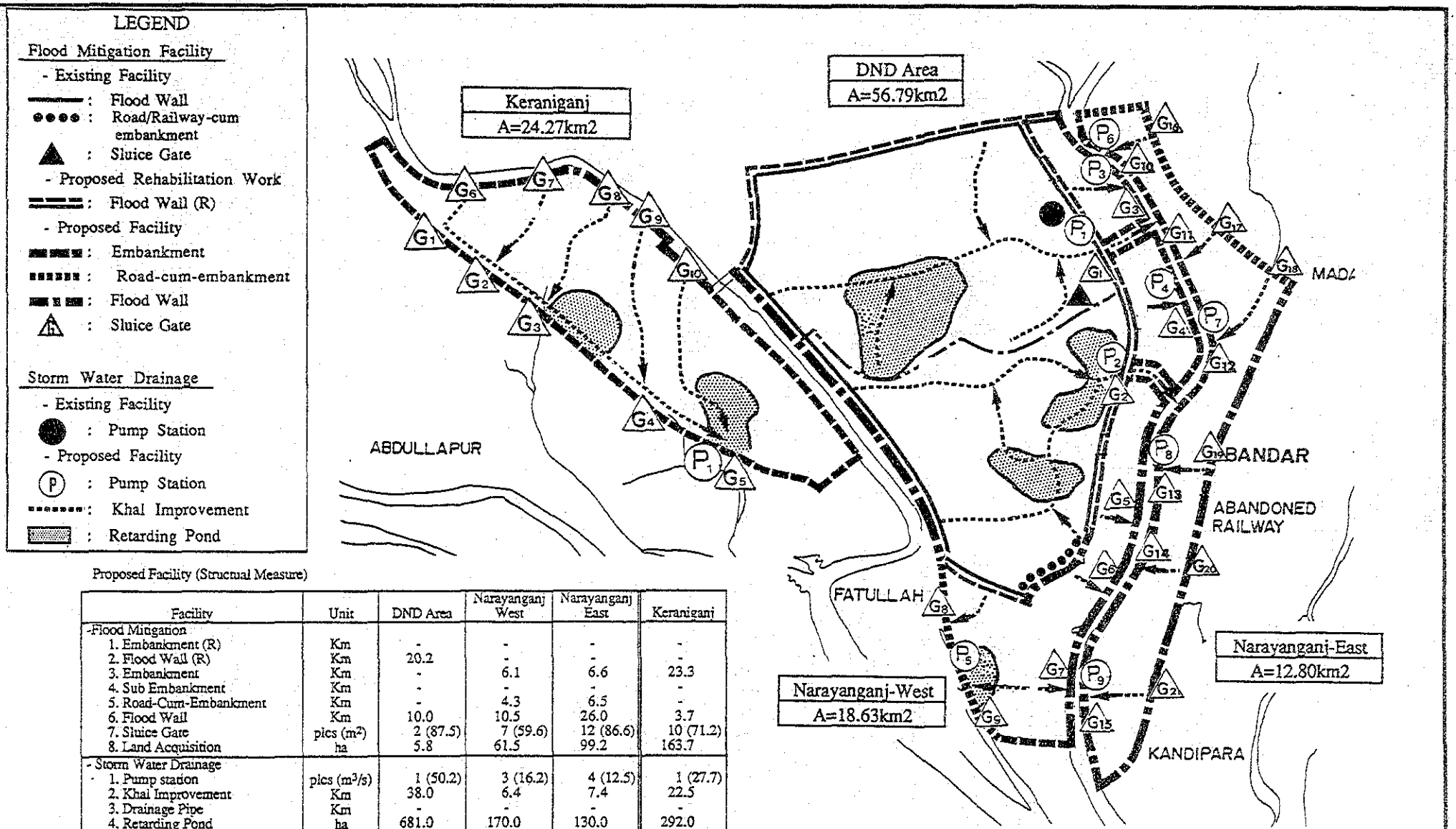
Note :
1) On-going projects by JICA and IBRD are not inclueded.
2) (R) : Rehabilitation Work

**FIG. K.2** **PROJECT AREAS WITH PROPOSED FACILITIES - GREATER DHAKA - WEST AND EAST**

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



JICA




Proposed Facility (Structual Measure)

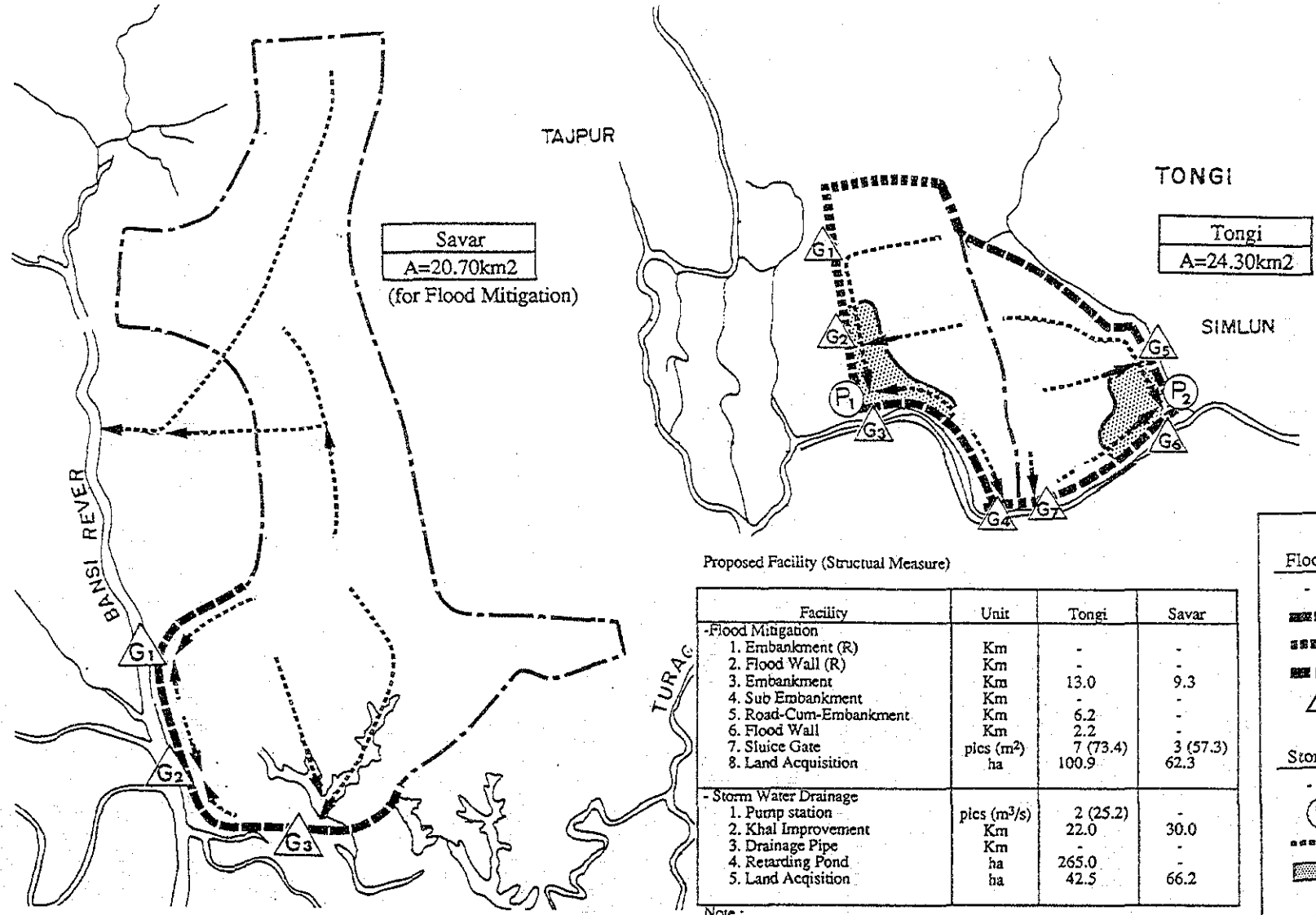
| Facility | Unit | DND Area | Narayanganj West | Narayanganj East | Keraniganj |
|---|---|---|---|---|---|
| -Flood Mitigation | | | | | |
| 1. Embankment (R) | Km | - | - | - | - |
| 2. Flood Wall (R) | Km | 20.2 | - | - | - |
| 3. Embankment | Km | - | 6.1 | 6.6 | 23.3 |
| 4. Sub Embankment | Km | - | - | - | - |
| 5. Road-Cum-Embankment | Km | - | 4.3 | 6.5 | - |
| 6. Flood Wall | Km | 10.0 | 10.5 | 26.0 | 3.7 |
| 7. Sluice Gate | pics ($m^2$) | 2 (87.5) | 7 (59.6) | 12 (86.6) | 10 (71.2) |
| 8. Land Acquisition | ha | 5.8 | 61.5 | 99.2 | 163.7 |
| - Storm Water Drainage | | | | | |
| 1. Pump station | pics ($m^3/s$) | 1 (50.2) | 3 (16.2) | 4 (12.5) | 1 (27.7) |
| 2. Khal Improvement | Km | 38.0 | 6.4 | 7.4 | 22.5 |
| 3. Drainage Pipe | Km | - | - | - | - |
| 4. Retarding Pond | ha | 681.0 | 170.0 | 130.0 | 292.0 |
| 5. Land Acquisition | ha | 90.8 | 12.2 | 14.1 | 50.6 |

Note :
1) On-going projects by JICA and IBRD are not inclueded.
2) (R) : Rehabilitation Work

FIG. K.3

PROJECT AREAS WITH PROPOSED FACILITIES - NARAYANGANJ DND AREA, NARAYANGANJ - WEST, EAST AND KERANIGANJ

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH




Proposed Facility (Structual Measure)

| Facility | Unit | Tongi | Savar |
|---|---|---|---|
| -Flood Mitigation | | | |
| 1. Embankment (R) | Km | - | - |
| 2. Flood Wall (R) | Km | - | - |
| 3. Embankment | Km | 13.0 | 9.3 |
| 4. Sub Embankment | Km | - | - |
| 5. Road-Cum-Embankment | Km | 6.2 | - |
| 6. Flood Wall | Km | 2.2 | - |
| 7. Sluice Gate | pics ($m^2$) | 7 (73.4) | 3 (57.3) |
| 8. Land Acquisition | ha | 100.9 | 62.3 |
| - Storm Water Drainage | | | |
| 1. Pump station | pics ($m^3/s$) | 2 (25.2) | - |
| 2. Khal Improvement | Km | 22.0 | 30.0 |
| 3. Drainage Pipe | Km | - | - |
| 4. Retarding Pond | ha | 265.0 | - |
| 5. Land Acqisition | ha | 42.5 | 66.2 |

Note :
1) On-going projects by JICA and IBRD are not inclueded.
2) (R) : Rehabilitation Work

LEGEND

Flood Mitigation Facility
- Proposed Facility
: Embankment
: Road-cum-embankment
: Flood Wall
: Sluice Gate

Storm Water Drainage
- Proposed Facility
: Pump Station
: Khal Improvement
: Retarding Pond

: Boundary of Drainage Zone

**FIG. K.4** **PROJECT AREAS WITH PROPOSED FACILITIES - TONGI AND SAVAR**

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

SUPPORTING REPORT L

PROJECT EVALUATION

# SUPPORTING REPORT L
# PROJECT EVALUATION

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# SUPPORTING REPORT L: PROJECT EVALUATION

## 1. General

The flood protection and rain water drainage project is implemented primarily to protect the properties such as houses, shops, factories, roads and bridges from damages due to inundation. That is to say, one can expect a reduction of flood damages by implementing such a project. This is the benefits of the project.

On the other hand, implementation of the project entails the construction/installation of various facilities and equipment such as embankments, sluice gates, flood wall and pump stations accompanying capital costs. Also, after project implementation those facilities and equipment have to be operated/maintained on regular or ad hoc basis, thus requiring recurrent costs.

The project is evaluated by comparing the costs with the benefits: if the benefits are big enough compared with the costs the project can be judged to be feasible.

However, actually things are not as simple as stated above. Various kinds of indirect benefits and costs can be expected surrounding project implementation.

On the cost (or negative benefit) side one has to take into consideration the resettlement of people who happen to be living between embankments and rivers, reduction of agricultural production due to urbanization of flood protected area, negative impacts on people earning livelihood by fishing and inland water transportation, possible negative impacts on ecology and on directions of water courses, etc.

On the benefit side one can consider a reduction of the outbreaks of water-borne diseases, elevation of cropping intensity in the flood protected agricultural areas, creation of employment during and after project implementation, acceleration of urbanization and economic activities inside the flood protected areas, etc.

One will have to consider and weigh all these things if one is to make a comprehensive evaluation of the flood protection and drainage project.

However, there is a more fundamental concept or argument. It is that for people to be protected from floods and inundations is one of basic human needs like urban water,

road, medical service and education and, therefore, the project is beyond the realm of economic evaluation.

For all the above issues and viewpoint it is nevertheless worthwhile to make economic evaluation just to know "the extent of usefulness in quantitative terms" so that projects can be compared with one another or this kind of project can be compared with projects of similar nature.

In making economic analysis, one has to convert costs and benefits in economic terms.

The period of project life was assumed to be 30 years. The opportunity cost of capital is assumed as 12%. These are based on the "FAP: Guidelines of Economic (Micro) Analysis".

## 2. Benefits

### 2.1 Expected Benefits

As mentioned above, various kinds of benefits can be expected in the event the project is implemented.

Major benefits will derive from the reduction of direct flood damages to properties such as houses, shops, factories and institutions, the reduction of income losses due to inability to engage in economic activities in time of floods and the reduction of direct flood damages to agricultural crops.

Also can be expected the reduction of direct flood damages to infrastructures such as roads, bridges, power supply, gas supply, water supply, telecommunication and transportation facilities and the reduction of flood damages to traffic in the form of more oil consumption due to taking of roundabout routes and slowing down of vehicle operating speed.

One of the major indirect benefits will be the reduction of the outbreaks of water-borne diseases. In the unprecedentedly big flood of 1988, enormous number of people around the study area fell victim to the attacks of dysentery, diarrhoea and malaria. (Refer to Table L.1.)

The removal of psychological burdens people have had to shoulder perpetually, though difficult to quantify, will be another big benefit accompanying far-reaching implications and effects. That is to say, people's mental attitudes will take a positive, active turn, eventually contributing to the overall elevation of their socio-economic activities.

Provision of employment opportunities during construction of facilities as well as for the operation/maintenance of facilities cannot be overlooked especially in a circumstance where labor market is perpetually over-supplied. Also important are multiplier effects the construction of flood protection and drainage facilities will bring about to the economy of the study area.

Furthermore, land use in the flood protected areas will be elevated. For instance, agricultural land or the land of lesser use will get urbanized for residential, commercial or other higher-degree uses. Or, intensity of cropping on the agricultural land will be heightened. These more advanced uses of land will be reflected in higher values of land.

## 2.2 Methodology for Benefit Estimation

The methodology for the estimation of flood damages is described in the Supporting Report E. In that report average annual flood damages for 1990 and 2010 are calculated on the assumption that the maximum return period is a hundred years. Those flood damages were/are expected in the "without project" situation. In the "with project" situation, that is to say, in the situation where the flood protection and drainage project is implemented with the facility design based on the return period of a hundred years the exact amount of those flood damages just turns into benefits.

That is to say, flood damages and project benefits denote different facets of the same thing.

Under the Flood Action Plan 8A, the JICA Study Team proposes eight major projects dividing the study area into the same number of areas. Those projects or areas are shown hereunder.

> Greater Dhaka West, Greater Dhaka East, Narayanganj DND, Narayanganj West, Narayanganj East, Keraniganj, Savar and Tongi

The eight areas will be enclosed by embankments constituting eight polders. The number of properties such as houses, shops, factories, institutions and farms within

each polder is estimated for 1990 and 2010. The average unit values of those properties are prepared for 1990 and 2010. The average depths/durations of inundation in 1987-scale and 1988-scale floods in the "without project" situation are provided for each Zone within those eight areas. Further, one comes up with regression equations formulating the relationships between inundation depths/durations and flood damage ratios.

Combining all these things one estimates flood damages in both 1987-scale and 1988-scale floods in the "without project" situation for 1990 and 2010 in each of the eight areas.

Subsequently average annual flood damages are calculated for 1990 and 2010 in the said areas. Eventually twenty percent addition is rendered to make allowances for flood damages to infrastructures and traffic. This way, ultimate average annual flood damage potentials are estimated for the present and for the target year in the designated eight areas.

In the "with project" situation they just turn into benefits. The benefits for each of the intermediate years between 1990 and 2010 as well as for each of the years beyond 2010 are estimated by adopting a simple time-series equation.

Flood damages to agricultural crops were estimated by combining the number of farm houses for 1990 and 2010 within a particular area, average cropped area per farm house in the flood season (0.690 ha), average productivity per unit cropped area (Tk 10,456/ha), average depths/durations of inundation for each Zone in that particular area in 1987-scale and 1988-scale floods, relationships between inundation depths/durations of built-up areas and those of farm lands (Table E.10 and E.11), relationships between inundation depths/durations of farm lands and ratios of flood damages to crops (Table E.10 and E.11) and average value added ratio of crops (86.5%).

The conversion factor of 0.95 was applied to the value of crops based on the "FAP: Guidelines on Economic (Micro) Analysis".

Indirect benefits such as the reduction of the outbreaks of water-borne diseases and intangible benefits such as the removal of psychological burden were not "counted in" in the actual benefit calculation.

## 2.3 Estimation of Benefits

The expected detailed benefits by item by scale of floods by Project for the present and the target year are shown in Table L.2.

Table L.3 presents summarised and more comprehensive benefits by major item by scale of floods by Project for 1990 and 2010. Fig.L.1 sammarizes Table L.3 (1), showing the relationships between return periods and benefits.

Mention will be made hereunder of the expected average annual benefits by Project in the above two years.

In the Greater Dhaka West Project the expected benefits in 1990 work out at Tk 897.4 million. In the target year of 2010 they will grow 2.64 times to Tk 2,366.4 million. In the Greater Dhaka East Project the expected benefits in 1990 work out at Tk 697.5 million, which will grow 2.87 times to Tk 2,000.7 million in 2010.

In the same way, in the Narayanganj DND Project the expected benefits in 1990 and 2010 work out at Tk 206.7 million and Tk 549.0 million, respectively. In the Narayanganj West Project the expected benefits are calculated at Tk 73.4 million for 1990 and Tk 288.4 million for 2010, while in the Narayanganj East Project the expected benefits in 1990 amount to Tk 61.0 million and in 2010 they will rise to Tk 166.3 million.

In the Keraniganj Project benefits amounting to Tk 169.4 million were expected in 1990, and in 2010 benefits are expected to reach Tk 430.3 million. In the Savar Project the expected benefits were Tk 12.5 million as of 1990, which will increase to Tk 43.1 million in the target year. In the Tongi Project the average annual benefits for the present are calculated at Tk 55.2 million, while in 20 years they will grow to Tk 311.2 million.

Summing up, the total benefits across the eight Projects that were expected in 1990 work out at Tk 2,173.1 million. In the target year of 2010 the total expected benefits are estimated to multiply by 2.83 times to Tk 6,155.4 million.

## 3. Costs

### 3.1 General

Costs are divided into capital cost which is required to install/construct necessary equipment/facilities concerned, and operation and maintenance (O/M) cost which is required after the implementation of a project.

In performing economic analysis costs have to be converted into economic costs. To convert capital cost into economic cost, a conversion factor is employed for a specific type of works.

To work out a conversion factor for a specific type of works, the works were firstly broken down into cost items, secondly the ratios of foreign and local components were calculated for each cost item, thirdly conversion factors specific to those components were given, and lastly the above procedures were combined together to arrive at a compound conversion factor specific to that type of works. (Refer to Table L.4.) In working out such a conversion factor the "FAP: Guidelines on Economic (Micro) Analysis" was referred to.

The resultant conversion factors are 89.8% for embankment, 85.2% for flood wall, 97.2% for sluice gate, 95.1% for pump station and 88.0% for khal improvement.

Regarding land acquisition cost, it was valued as a stream of annual net benefits of production foregone in conformity to the "FAP: Guidelines on Economic (Micro) Analysis".

O/M cost was assumed to be 0.5% of capital cost excluding land acquisition cost.

Besides the above-mentioned capital and O/M costs, one has to take into consideration the cost of resettlement of people living along rivers who will not be protected by embankments. Also, one can cite losses of agricultural revenue resulting from the expected reduction of agricultural land within the flood protected areas. Such losses are estimated to sum up to Tk 182.9 million in 2010 on annual basis. (Refer to Table L.5.)

One can cite, further, the loss of livelihood of certain number of people engaged in inland water fishing or transportation.

## 3.2 Estimation of Economic Costs

Based on the above concept and procedures economic capital cost excluding land acquisition cost was calculated for each of the eight Projects. (Refer to Table L.6.)

Economic capital cost as defined above of the Greater Dhaka West Project works out at Tk 9,222.3 million, occupying 23.7% of the total capital cost combining the eight Projects, while that of the Greater Dhaka East Project amounts to Tk 14,430.0 million, accounting for 37.1%.

The cost related to the Greater Dhaka West embankments and Narayanganj DND flood walls which are already constructed is included in the above cost.

Capital cost for the Narayanganj DND, West and East Projects comes to Tk 3,232.1 million, Tk 1,550.0 million and Tk 2,102.0 million, accounting for 8.3%, 4.0% and 5.4%, respectively.,

Capital cost of the Keraniganj Project is calculated at Tk 4,086.6 million (10.5%). Likewise, that of the Savar and Tongi Projects is calculated at Tk 1,700.7 million (4.4%) and Tk 2,589.2 million (6.7%), respectively.

The above eight economic capital cost sums up to Tk 38,912.9 million.

The cost of land acquisition in each Project was annualized in the form of net benefits of production foregone. Such annual cost at 1991 prices is estimated at Tk 9.8 million for the Greater Dhaka West Project, Tk 27.3 million for the Greater Dhaka East Project, Tk 8.9 million for the Narayanganj DND Project, Tk 2.8 million for the Narayanganj West Project, Tk 2.8 million for the Narayanganj East Project, Tk 5.8 million for the Keraniganj Project, Tk 1.5 million for the Savar Project and Tk 4.7 million for the Tongi Project. They add up to Tk 63.6 million.

The cost of resettlement combining the eight Projects is estimated at Tk 413.3 million at 1991 prices based on 1990 population. Its project wise breakdown is shown in Table L.5.

Annual O/M cost of the eight Projects combined is estimated to come to Tk 194.6 million, Project wise detail of which is shown in Table L.6.

## 4. Project Evaluation

### 4.1 Preconditions

In preparing cost benefit streams, the period of project life was basically assumed to be 30 years. Also, in calculating benefit cost ratio (B/C) and net present value (NPV), opportunity cost of capital (OCC) was assumed to be twelve percent.

The capital cost already invested was assumed to have been disbursed in the first year of the cost benefit streams. The capital cost of the on-going projects was distributed over years based on the existing implementation schedules. In preparing the cost benefit streams combining the eight Projects, capital cost was distributed over years in accordance with the priority order of these projects. Replacement cost of pumps was taken into account.

The annual O/M cost was assigned to each year on the assumptions that the requirements for the said cost increase in parallel with the extent of the cumulative disbursement of the capital cost.

Potential benefits were assumed to increase from 1990 to 2010 and beyond tracing a straight line. Potential benefits in a certain year will turn into real benefits in proportion to the cumulative cost realized up to the said year.

### 4.2 Calculation of NPV, B/C and EIRR

Cost benefit streams for each of the eight Projects as well as for the combined total are shown in Table L.7. Based on them economic analysis was conducted. The results are presented in Table L.8.

According to Table L.8 the Greater Dhaka West Project has the highest economic internal rate of return (EIRR) of 18.3% among the eight Projects. This EIRR is by 6.3% higher than the OCC of 12%.

The second highest EIRR belongs to the Narayanganj DND Project with 14.2%. The Narayanganj West Project is placed third with 13.7%. The Greater Dhaka East Project

is placed fourth with 12.3%. It is to be noted that all these four Projects have the EIRR's surpassing OCC.

The Greater Dhaka West Project has the greatest NPV reaching Tk. 4,433 million along with the highest B/C of 1.52. NPV of the Narayanganj DND, Narayanganj West and Greater Dhaka East Projects is calculated at Tk. 363 million, Tk. 177 million and Tk. 149 million, respectively, and their respective B/C's come to 1.16, 1.14 and 1.02.

When the two Greater Dhaka Projects are combined together, one gets the EIRR of 15.3%, the NPV of Tk. 4,570 million and the B/C of 1.27. Likewise, when the three Narayanganj Projects are bundled together, EIRR, NPV and B/C are rendered to 13.5%, Tk. 456 million and 1.11, respectively.

The Tongi, Keraniganj and Narayanganj East Projects have the EIRR of 11.8%, 10.0%, and 7.4%, respectively. EIRR could not be computed for the Savar Project.

The EIRR of the eight Projects combined works out at 14.3%, which is by 2.3 points above the assumed OCC. Also, the combined NPV and B/C work out at Tk. 4,388 million and 1.18, respectively.

## 4.3 Sensitivity Analysis

Sensitivity analysis was conducted to know how the value of EIRR for each Project will be affected if things turn out to be better or harder than what is estimated.

In the Case I one assumes that benefits will be greater by 20% than the standard estimates. This is a positive or optimistic assumption. Under Case II it is assumed that the costs will be greater by 20% than the standard estimates. This is a negative or pessimistic assumption.

As a result of sensitivity analysis it was found out that under Case I EIRR of all Projects except that of the Narayanganj East and Savar Projects turns greater than OCC as shown under: (Refer to Table L.9.)

| Project | | EIRR |
|---|---|---|
| Greater Dhaka West | : | 22.0 % |
| Narayanganj DND | : | 17.2 % |
| Narayanganj West | : | 16.4 % |
| Greater Dhaka East | : | 14.7 % |

| | | |
|---|---|---|
| Tongi | : | 14.2 % |
| Keraniganj | : | 12.3 % |

Under Case II No. of those Projects having two digit EIRR's is reduced to four as shown below.

| Project | | EIRR |
|---|---|---|
| Greater Dhaka West | : | 15.3 % |
| Narayanganj DND | : | 11.6 % |
| Narayanganj West | : | 11.5 % |
| Greater Dhaka East | : | 10.2 % |

As shown above the Greater Dhaka West Project is the only project maintaining an EIRR greater than OCC.

## 4.4 Conclusion

It follows from the above that all the Projects excepting the Narayanganj East and Savar Project are positioned on or above the border line of economic feasibility. The Greater Dhaka West Project will stay economically robust under conceivably unfavorable circumstances. The Savar Project is judged to be not feasible at least in economic terms.

The Greater Dhaka West Project area and the Greater Dhaka East Project area form one entity administratively, geographically and economically. Although the latter area is now comparatively underdeveloped, the whole Greater Dhaka area should be evenly developed in the future because of the above-mentioned reasons. In this sense it will be reasonable to make an evaluation combining the two Projects.

The average annual flood damage potentials in the combined areas of the two Greater Dhaka Projects are estimated at Tk. 1,594.9 million as of 1990. This amount occupies 73.4% of or nearly three fourths of Tk. 2,173.1 million, which is the average annual flood damage potentials in the combined areas of the eight Projects for the same year. In the target year of 2010 the damage potentials in the Greater Dhaka Project areas is estimated to grow 2.74 times to Tk. 4,367.1 million, accounting for 70.9% of Tk 6,155.4 million, which is the estimated damage potentials in the combined areas of the eight Projects in the said year. (Refer to Table L.3.)

On the cost side, the combined economic capital cost of the two Greater Dhaka Projects is estimated to total Tk. 23,652.3 million. On the other hand, the combined economic capital cost of the eight Projects works out to Tk. 38,912.9 million. That is to say, the share of the two Greater Dhaka Projects in respect of economic capital cost reaches 60.8%. (Refer to Table L.6.)

What derives from the above is that the Greater Dhaka Projects will play the central or dominant role under Flood Action Plan No. 8A in terms of benefits as well as costs.

These two Projects having such an importance, when combined together, can be said to be economically not only viable, but also robust, maintaining a feasible level even under adverse circumstances.

The three Narayanganj Projects, when joined together, are estimated to produce the benefits amounting to Tk. 1,003.7 million in 2010, accounting for 16.3% of the entire benefits to be realized by the eight Projects. In terms of economic capital cost they will combinedly require Tk. 6,884.1 million, accounting for 17.7 %. In other words, the Narayanganj Projects follow the Greater Dhaka Projects in respect of magnitude.

These three Projects, when merged together, can be said to be economically viable enough, with the EIRR safely over OCC.

The above five Projects combinedly occupy 87.3% of the benefits to be expected in 2010 as well as 78.5% of the economic capital cost to be required in implementing them.

The two Projects of Tongi and Keraniganj have EIRR's that are good enough in a comparative sense. That is to say, it can be said that the EIRR level of 10 to 11% is on the high side for a social project such as this one. Besides, if benefits such as the reduction of water-borne diseases and higher values of land were taken into account in quantitative terms, then their EIRR's would rise to a feasible level as shown in Case I of sensitivity analysis.

The eight Projects envisioned under the Flood Action Plan No. 8A are intertwined in administrative, geographical, demographical and economic terms. That is to say, no Project can be separated out and treated independently. In this meaning the eight Projects will have to be dealt with as a single system or package. Fortunately, the eight

Projects, when treated as one entity, have turned out to have a sufficiently viable economic feasibility thanks to the dominant position of the Greater Dhaka Projects.

Many more benefits than the ones incorporated in the economic analysis can be expected in the event the Projects are implemented as already mentioned in 2.1. There will also arise costs or negative benefits that were excluded from the quantitative evaluation as stated in 3.1.

Among others, one can cite as such benefits the reduction of the breakouts of communicable diseases, creation of employment opportunities during and after project implementation, the releasing of psychological burdens ushering in greater socio-economic activities and the urbanization of land or upgrading of land use leading to the greater economic values of land within the flood protected areas. On the cost side, one of the major concerns will be over some negative or disturbing impacts/effects on the ecological system and other natural conditions.

However, it seems proper to say concerning the above cited unquantified benefits and costs that the benefits are more real, stronger and more direct than the costs.

Further, the fundamental question is if Dhaka, the capital of Bangladesh whose population along with that of the surrounding areas will surpass ten million sooner or later can be left open to the recurrent attacks of natural calamity by the name of debilitating floods. The question pertains to one of the fundamental human rights or basic human needs which must never be left unattended or il-attended to forever.

Table L.10 shows rankings of each of the eight Projects based on a more comprehensive criteria. According to it, the Greater Dhaka West, Greater Dhaka East, Narayanganj DND and Narayanganj West Projects are ranked as A. The Tongi and Keraniganj Projects are rated as B. And the Narayanganj and Savar Projects are evaluated as C.

**Table L.1 Reported Cases of Major Communicable Diseases in 1987 and 1988 in the Region of Dhaka**

(Unit: Cases)

| Item | | Dysentery | Diarrhoea | Malaria | Total |
|---|---|---|---|---|---|
| 1987 | (A) | 88,208 | 46,687 | 129,007 | 263,902 |
| 1988 | (B) | 232,729 | 55,617 | 154,540 | 442,886 |
| Difference | (B - A) | 144,521 | 8,930 | 25,533 | 178,984 |
| Ratio | ((B/A-1)*100) | +163.8% | +19.1% | +19.8% | +67.8% |
| (Per 1,000 Population | | | | | |
| 1987 | (A) | 7.3 | 3.9 | 10.7 | 21.9 |
| 1988 | (B) | 18.8 | 4.5 | 12.5 | 35.8 |
| Difference | (B - A) | 11.5 | 0.6 | 1.8 | 13.9 |
| Ratio | ((B/A-1)*100) | +157.5% | +15.4% | +16.8% | +63.5% |

Source: Statistical Yearbook of Bangladesh 1990 and JICA

## Table L.2(1) Benefits by Type of Properties by Project by Target Year

Bd = Building (s), H. E = Household Effects, Ic = Income, E & I = Equipment and Inventories, Pf = Profit, Cp = Crops

1) Year 1990

(Unit :Tk Million)

| Project | External Flood | | | | | | | | | | | Internal Flood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Residential | | | Commercial | | | Industrial | | | Institutional | Agricultural | |
| | Bd | H. E | Ic | Bd | E & I | Pf | Bd | E & I | Pf | Bd | Cp | |
| (1) 1987 - Scale Flood | | | | | | | | | | | | (1) Annual Flood |
| G. Dhaka West | 1,083 | 85 | 190 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 172 | 86 |
| G. Dhaka East | 413 | 21 | 122 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 212 | 226 |
| Nara. DND | 288 | 27 | 35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 70 | - |
| Nara. West | 71 | 3 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | - |
| Nara. East | 67 | 2 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | - |
| Keraniganj | 253 | 9 | 56 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | - |
| Savar | 8 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | - |
| Tongi | 58 | 2 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | - |
| TOTAL | 2,241 | 149 | 463 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 524 | 312 |
| (2) 1988- Scale Flood | | | | | | | | | | | | (2) Worst Flood |
| G. Dhaka West | 2,550 | 1,042 | 308 | 60 | 143 | 13 | 26 | 85 | 14 | 205 | 204 | 196 |
| G. Dhaka East | 1,590 | 773 | 238 | 39 | 87 | 8 | 22 | 75 | 12 | 233 | 250 | 468 |
| Nara.DND | 450 | 170 | 49 | 8 | 20 | 2 | 16 | 52 | 8 | 78 | 79 | - |
| Nara. West | 403 | 181 | 55 | 14 | 32 | 3 | 21 | 72 | 10 | 29 | 21 | - |
| Nara. East | 202 | 100 | 31 | 2 | 3 | 0 | 20 | 66 | 9 | 18 | 26 | - |
| Keraniganj | 605 | 219 | 63 | 15 | 36 | 3 | 9 | 28 | 5 | 14 | 12 | - |
| Savar | 75 | 32 | 8 | 1 | 1 | 0 | 7 | 21 | 4 | 13 | 10 | - |
| Tongi | 195 | 93 | 25 | 8 | 22 | 2 | 54 | 182 | 30 | 51 | 14 | - |
| TOTAL | 6,070 | 2,610 | 777 | 147 | 344 | 31 | 175 | 581 | 92 | 641 | 616 | 664 |

Source : JICA

## Table L.2 (2) Benefits by Type of Properties by Project by Target Year

Bd = Building (s), H. E = Household Effects, Ic = Income, E & I = Equipment and Inventories, Pf = Profit, Cp = Crops

2) Year 2010

(Unit :Tk Million)

| Project | External Flood | | | | | | | | | | | Internal Flood |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Residential | | | Commercial | | | Industrial | | | Institutional | Agricultural | |
| | Bd | H. E | Ic | Bd | E & I | Pf | Bd | E & I | Pf | Bd | Cp | |
| (1) 1987 - Scale Flood | | | | | | | | | | | | (1) Annual Flood |
| G. Dhaka West | 3,408 | 260 | 568 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 21 | 155 |
| G. Dhaka East | 2,028 | 73 | 551 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 39 | 445 |
| Nara. DND | 883 | 82 | 108 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 28 | - |
| Nara. West | 394 | 18 | 99 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | - |
| Nara. East | 210 | 5 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | - |
| Keraniganj | 660 | 22 | 148 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | - |
| Savar | 37 | 1 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | - |
| Tongi | 360 | 14 | 80 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | - |
| TOTAL | 7,980 | 475 | 1,630 | 0 | 0 | 19 | 0 | 0 | 0 | 0 | 94 | 600 |
| (2) 1988- Scale Flood | | | | | | | | | | | | (2) Worst Flood |
| G. Dhaka West | 7,318 | 2,886 | 859 | 152 | 353 | 32 | 62 | 201 | 33 | 547 | 25 | 317 |
| G. Dhaka East | 5,826 | 2,772 | 862 | 114 | 254 | 24 | 47 | 159 | 25 | 746 | 46 | 922 |
| Nara.DND | 1,431 | 529 | 153 | 24 | 57 | 5 | 54 | 169 | 27 | 234 | 31 | - |
| Nara. West | 1,229 | 545 | 165 | 32 | 71 | 7 | 58 | 194 | 28 | 80 | 3 | - |
| Nara. East | 687 | 347 | 109 | 4 | 9 | 1 | 75 | 255 | 35 | 60 | 2 | - |
| Keraniganj | 1,591 | 580 | 168 | 32 | 74 | 7 | 25 | 76 | 13 | 37 | 1 | - |
| Savar | 368 | 158 | 40 | 3 | 7 | 1 | 32 | 105 | 18 | 64 | 1 | - |
| Tongi | 1,222 | 580 | 154 | 52 | 135 | 11 | 338 | 1,136 | 186 | 320 | 0 | - |
| TOTAL | 19,672 | 8,397 | 2,510 | 413 | 960 | 88 | 691 | 2,295 | 365 | 2,088 | 109 | 1,239 |

Source : JICA

## Table L.3 (1) Summary of Benefits by Project by Target Year

RCII = Residential, Commercial, Industrial and Institutional Properties, AC = Agricultural Crops, Ot = Others

(Unit : Tk Million)

| Project | External Flood | | | | | | | | Internal Flood | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1987 - Scale | | | | 1988 - Scale | | | | | |
| | RCII | AC | Ot | Total | RCII | AC | Ot | Total | Annual | Worst |
| (1) Year 1990 | | | | | | | | | | |
| G. Dhaka West | 1,361.1 | 172.2 | 306.7 | 1,839.9 | 4,445.7 | 204.0 | 929.9 | 5,579.6 | 86.0 | 195.5 |
| G. Dhaka East | 557.9 | 211.6 | 153.9 | 923.4 | 3,077.7 | 250.0 | 665.5 | 3,993.2 | 226.4 | 468.4 |
| Nara. DND | 351.3 | 69.7 | 84.2 | 505.2 | 852.8 | 79.2 | 186.4 | 1,118.4 | - | - |
| Nara. West | 98.6 | 17.5 | 23.2 | 139.3 | 821.5 | 20.9 | 168.5 | 1,010.9 | - | - |
| Nara. East | 89.0 | 21.9 | 22.2 | 133.1 | 452.0 | 25.9 | 95.6 | 573.5 | - | - |
| Keraniganj | 318.7 | 10.2 | 65.8 | 394.7 | 998.0 | 12.0 | 202.0 | 1,212.0 | - | - |
| Savar | 9.6 | 8.3 | 3.6 | 21.5 | 162.9 | 9.7 | 34.5 | 207.1 | - | - |
| Tongi | 72.8 | 11.9 | 16.9 | 101.6 | 660.6 | 13.9 | 134.9 | 809.4 | - | - |
| TOTAL | 2,859.0 | 523.3 | 676.5 | 4,058.7 | 11,471.2 | 615.6 | 2,417.3 | 14,504.1 | 312.4 | 663.9 |
| (2) Year 2010 | | | | | | | | | | |
| G. Dhaka West | 4,244.1 | 21.2 | 853.1 | 5,118.4 | 12,442.4 | 25.0 | 2,493.5 | 14,960.9 | 155.5 | 317.0 |
| G. Dhaka East | 2,656.9 | 39.0 | 539.2 | 3,235.1 | 10,828.9 | 46.0 | 2,175.0 | 13,049.9 | 444.6 | 922.4 |
| Nara.DND | 1,074.7 | 27.6 | 220.5 | 1,322.8 | 2,683.3 | 31.1 | 542.9 | 3,257.3 | - | - |
| Nara. West | 512.1 | 2.4 | 102.9 | 617.4 | 2,408.9 | 2.9 | 482.4 | 2,894.2 | - | - |
| Nara. East | 282.2 | 1.7 | 56.8 | 340.7 | 1,582.9 | 2.0 | 317.0 | 1,901.9 | - | - |
| Keraniganj | 832.1 | 0.6 | 166.5 | 999.2 | 2,604.2 | 0.7 | 521.0 | 3,125.9 | - | - |
| Savar | 47.1 | 1.2 | 9.7 | 58.0 | 796.7 | 1.5 | 159.6 | 957.8 | - | - |
| Tongi | 455.2 | 0.0 | 91.0 | 546.2 | 4,133.1 | 0.0 | 826.6 | 4,959.7 | - | - |
| TOTAL | 10,104.4 | 93.7 | 2,039.7 | 12,237.8 | 37,480.4 | 109.2 | 7,518.0 | 45,107.6 | 600.1 | 1,239.4 |

Source : JICA

## Table L.3 (2) Summary of Benefits by Project by Target Year

(Unit:Tk Million)

| Project | Average Annual Flood | | |
|---|---|---|---|
| | External | Internal | Total |
| (1) Year 1990 | | | |
| Greater Dhaka West | 788.2 | 109.2 | 897.4 |
| Greater Dhaka East | 423.4 | 274.1 | 697.5 |
| Narayanganj DND | 206.7 | - | 206.7 |
| Narayanganj West | 73.4 | - | 73.4 |
| Narayanganj East | 61.0 | - | 61.0 |
| Keraniganj | 169.4 | - | 169.4 |
| Savar | 12.5 | - | 12.5 |
| Tongi | 55.2 | - | 55.2 |
| TOTAL | 1,789.8 | 383.3 | 2,173.1 |
| (2) Year 2010 | | | |
| Greater Dhaka West | 2,179.5 | 186.9 | 2,366.4 |
| Greater Dhaka East | 1,461.5 | 539.2 | 2,000.7 |
| Narayanganj DND | 549.0 | - | 549.0 |
| Narayanganj West | 288.4 | - | 288.4 |
| Narayanganj East | 166.3 | - | 166.3 |
| Keraniganj | 430.3 | - | 430.3 |
| Savar | 43.1 | - | 43.1 |
| Tongi | 311.2 | - | 311.2 |
| TOTAL | 5,429.3 | 726.1 | 6,155.4 |

## Table L.4(1) Conversion Factors by Type of Works

1. Embankment

(Unit : %)

| Cost Item | Machinery/ Equipment | | Construction | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | | Materials | | Machinery/ Equipment | | Labor | | |
| Cost Ratio | - | | 30.8 | | 65.8 | | 3.4 | | 100.0 |
| F/C L/C | F/C | L/C | F/C | L/C | F/C | L/C | F/C | L/C | - |
| Ratio | - | - | 50 | 50 | 70 | 30 | - | 100 | - |
| Conversion Factors | - | - | 100 | 82 | 100 | 67.6 | - | 71 | 89.8 |

2. Flood Wall

(Unit : %)

| Cost Item | Machinery/ Equipment | | Construction | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | | Materials | | Machinery/ Equipment | | Labor | | |
| Cost Ratio | - | | 67.7 | | 28.0 | | 4.3 | | 100.0 |
| F/C L/C | F/C | L/C | F/C | L/C | F/C | L/C | F/C | L/C | - |
| Ratio | - | - | 50 | 50 | 70 | 30 | - | 100 | - |
| Conversion Factors | - | - | 100 | 68 | 100 | 67.6 | - | 71 | 85.2 |

3. Sluice Gate

(Unit : %)

| Cost Item | Machinery/ Equipment | | Construction | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | | Materials | | Machinery/ Equipment | | Labor | | |
| Cost Ratio | 28.3 | | 48.6 | | 20.1 | | 3.0 | | 100.0 |
| F/C L/C | F/C | L/C | F/C | L/C | F/C | L/C | F/C | L/C | - |
| Ratio | 100 | - | 100 | - | 70 | 30 | - | 100 | - |
| Conversion Factors | 100 | - | 100 | - | 100 | 67.6 | - | 71 | 97.2 |

## Table L.4(2) Conversion Factors by Type of Works

4. Pump Station

(Unit : %)

| Cost Item | Machinery/ Equipment | Construction | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | Materials | | Machinery/ Equipment | | Labor | | |
| Cost Ratio | 66.7 | 22.6 | | 9.3 | | 1.4 | | 100.0 |
| F/C L/C | F/C L/C | F/C | L/C | F/C | L/C | F/C | L/C | - |
| Ratio | - - | 50 | 50 | 70 | 30 | - | 100 | - |
| Conversion Factors | 100 - | 100 | 68 | 100 | 67.5 | - | 71 | 95.1 |

5. Khal Improvement

(Unit : %)

| Cost Item | Machinery/ Equipment | Construction | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | Materials | | Machinery/ Equipment | | Labor | | |
| Cost Ratio | - | 49.3 | | 46.4 | | 4.3 | | 100.0 |
| F/C L/C | F/C L/C | F/C | L/C | F/C | L/C | F/C | L/C | - |
| Ratio | - - | 30 | 70 | 70 | 30 | - | 100 | - |
| Conversion Factors | - - | 100 | 82 | 100 | 67.5 | - | 71 | 88.0 |

Source : JICA

Table L.5 Negative Impacts of Project

1. Costs of Resettlement

(Unit: Tk million)

| Project | No. of Houses | Value of Houses to be Lost | Transportation Cost | Total |
|---|---|---|---|---|
| Greater Dhaka West | 1,516 | 50.4 | 0.3 | 50.7 |
| Greater Dhaka East | 2,696 | 89.5 | 0.6 | 90.1 |
| Narayanganj DND | - | - | - | - |
| Narayanganj West | 2,012 | 66.8 | 0.4 | 67.2 |
| Narayanganj East | 1,608 | 53.4 | 0.3 | 53.7 |
| Keraniganj | 3,020 | 100.3 | 0.6 | 100.9 |
| Savar | 577 | 19.2 | 0.1 | 19.3 |
| Tongi | 938 | 31.2 | 0.2 | 31.4 |
| TOTAL | 12,367 | 410.8 | 2.5 | 413.3 |

Notes: 1. No. of houses is on household basis.
2. Average value of building(s) of a household along rivers is estimated at Tk 33,216.
3. Transportation cost is assumed to be Tk 200 per household.
4. Based on 1990 population.

2. Reduction of Agricultural Revenue

(Unit: Tk million)

| Area | Agricultural area (ha) | | | Annual net revenue to be lost |
|---|---|---|---|---|
| | 1990 (A) | 2010 (B) | Difference (C=A-B) | |
| Dhaka | 11,109 | 3,278 | 7,831 | 90.1 |
| Narayanganj | 4,170 | 1,155 | 3,015 | 34.7 |
| Keraniganj | 1,469 | 89 | 1,380 | 15.9 |
| Savar | 3,236 | 909 | 2,327 | 26.8 |
| Tongi | 1,348 | 0 | 1,348 | 15.5 |
| TOTAL | 21,332 | 5,431 | 15,901 | 182.9 |

Notes : 1. Agricultural area = Agricultural area to be enclosed by embankments.
2. Cropping intensity and productivity per cropped area are estimated at 140% and Tk 10,000/ha, respectively.
3. Value added ratio is estimated at 86.5%.
4. The average conversion factor of agricultural products is estimated at 0.85.

Source: JICA

Table L.6(1) Economic Costs by Project

1. Capital Cost

(Unit: Tk Million)

| Project | Embankment | Flood Wall | Sluice Way | Others | Sub-Total |
|---|---|---|---|---|---|
| G. Dhaka West | 2,386.4 | 262.5 | 621.1 | 497.3 | 3,767.3 |
| G. Dhaka East | 3,216.3 | - | 541.6 | 1,289.7 | 5,047.6 |
| Nara. DND | - | 330.5 | 278.5 | 167.0 | 776.0 |
| Nara. West | 249.4 | 111.9 | 277.4 | 216.4 | 855.1 |
| Nara. East | 364.0 | 357.5 | 409.0 | 388.2 | 1,518.7 |
| Keraniganj | 1,523.9 | 110.7 | 361.2 | 685.1 | 2,680.9 |
| Savar | 570.5 | - | 229.8 | 271.6 | 1,071.9 |
| Tongi | 646.2 | 21.6 | 332.1 | 338.6 | 1,338.5 |
| TOTAL | 8,956.7 | 1,194.7 | 3,050.7 | 3,853.9 | 17,056.0 |

(Unit: Tk Million)

| Project | Pump Station | Khal Improvement | Others | Sub-Total | Total |
|---|---|---|---|---|---|
| G. Dhaka West | 2,269.3 | 1,875.6 | 1,310.1 | 5,455.0 | 9,222.3 |
| G. Dhaka East | 3,925.1 | 3,093.3 | 2,364.0 | 9,382.4 | 14,430.0 |
| Nara. DND | 1,155.5 | 680.9 | 619.7 | 2,456.1 | 3,232.1 |
| Nara. West | 437.3 | 84.4 | 173.2 | 694.9 | 1,550.0 |
| Nara. East | 343.7 | 93.8 | 145.8 | 583.3 | 2,102.0 |
| Keraniganj | 674.5 | 376.8 | 354.4 | 1,405.7 | 4,086.6 |
| Savar | - | 464.4 | 164.4 | 628.8 | 1,700.7 |
| Tongi | 653.7 | 282.7 | 314.3 | 1,250.7 | 2,589.2 |
| TOTAL | 9,459.1 | 6,951.9 | 5,445.9 | 21,856.9 | 38,912.9 |

Notes: 1. "Others" includes physical contingencies, engineering fees, administration costs, etc.

2. The capital costs of the already implemented and on-going projects are included.

Table L.6(2) Economic Costs by Project

2. Annual Net Benefits of Production Foregone

(Unit: Tk Million)

| Project | Land Acquisition (ha) | Annual Net Benefits of Production Foregone |
|---|---|---|
| G. Dhaka West | 850.7 | 9.8 |
| G. Dhaka East | 2,369.4 | 27.3 |
| Nara. DND | 777.6 | 8.9 |
| Nara. West | 243.7 | 2.8 |
| Nara. East | 243.3 | 2.8 |
| Keraniganj | 506.3 | 5.8 |
| Savar | 128.5 | 1.5 |
| Tongi | 408.4 | 4.7 |
| TOTAL | 5,527.9 | 63.6 |

Note: Cropping intensity, agricultural productivity per ha, value added ratio and the conversion factor of agricultural products are assumed to be on average 140%, Tk 10,000, 86.5% and 0.95, respectively.

3. Annual Operation and Maintenance Cost

(Unit: Tk Million)

| Project | O & M Cost |
|---|---|
| G. Dhaka West | 46.1 |
| G. Dhaka East | 72.2 |
| Nara. DND | 16.2 |
| Nara. West | 7.8 |
| Nara. East | 10.5 |
| Keraniganj | 20.4 |
| Savar | 8.5 |
| Tongi | 12.9 |
| TOTAL | 194.6 |

Source: JICA

Table L.7(1) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
SCF=Cash Flow (=BF - CS)

1. Greater Dhaka West Project

(Unit:Tk Million)

| NO. | YEAR | CC | OM | CS | BF | CF |
|---|---|---|---|---|---|---|
| 1 | 1995 | 5485 | 27 | 5512 | 645 | -4867 |
| 2 | 1996 | 802 | 31 | 833 | 782 | -51 |
| 3 | 1997 | 802 | 35 | 837 | 930 | 93 |
| 4 | 1998 | 802 | 39 | 841 | 1089 | 248 |
| 5 | 1999 | 802 | 43 | 845 | 1259 | 414 |
| 6 | 2000 | 456 | 45 | 502 | 1381 | 879 |
| 7 | 2001 | 420 | 47 | 468 | 1509 | 1041 |
| 8 | 2002 | 420 | 49 | 470 | 1642 | 1173 |
| 9 | 2003 | 420 | 51 | 472 | 1781 | 1310 |
| 10 | 2004 | 420 | 53 | 474 | 1926 | 1452 |
| 11 | 2005 | 10 | 53 | 63 | 1999 | 1936 |
| 12 | 2006 | 10 | 53 | 63 | 2073 | 2009 |
| 13 | 2007 | 10 | 53 | 63 | 2146 | 2083 |
| 14 | 2008 | 10 | 53 | 63 | 2220 | 2156 |
| 15 | 2009 | 10 | 53 | 63 | 2293 | 2230 |
| 16 | 2010 | 408 | 53 | 462 | 2366 | 1905 |
| 17 | 2011 | 10 | 53 | 63 | 2440 | 2377 |
| 18 | 2012 | 10 | 53 | 63 | 2513 | 2450 |
| 19 | 2013 | 10 | 53 | 63 | 2587 | 2524 |
| 20 | 2014 | 10 | 53 | 63 | 2660 | 2597 |
| 21 | 2015 | 408 | 53 | 462 | 2734 | 2272 |
| 22 | 2016 | 10 | 53 | 63 | 2807 | 2744 |
| 23 | 2017 | 10 | 53 | 63 | 2881 | 2817 |
| 24 | 2018 | 10 | 53 | 63 | 2954 | 2891 |
| 25 | 2019 | 10 | 53 | 63 | 3027 | 2964 |
| 26 | 2020 | 10 | 53 | 63 | 3101 | 3038 |
| 27 | 2021 | 10 | 53 | 63 | 3174 | 3111 |
| 28 | 2022 | 10 | 53 | 63 | 3248 | 3185 |
| 29 | 2023 | 10 | 53 | 63 | 3321 | 3258 |
| 30 | 2024 | 10 | 53 | 63 | 3395 | 3332 |
| 31 | 2025 | 408 | 53 | 462 | 3468 | 3007 |
| 32 | 2026 | 10 | 53 | 63 | 3542 | 3478 |
| 33 | 2027 | 10 | 53 | 63 | 3615 | 3552 |
| 34 | 2028 | 10 | 53 | 63 | 3689 | 3625 |
| 35 | 2029 | 10 | 53 | 63 | 3762 | 3699 |

2. Greater Dhaka East Project

(Unit:Tk Million)

| NO. | YEAR | CC | OM | CS | BF | CF |
|---|---|---|---|---|---|---|
| 1 | 1995 | 1521 | 7 | 1529 | 102 | -1427 |
| 2 | 1996 | 1251 | 13 | 1264 | 202 | -1062 |
| 3 | 1997 | 1251 | 20 | 1271 | 313 | -958 |
| 4 | 1998 | 1251 | 26 | 1277 | 435 | -841 |
| 5 | 1999 | 1251 | 32 | 1283 | 569 | -714 |
| 6 | 2000 | 1148 | 37 | 1185 | 697 | -489 |
| 7 | 2001 | 1076 | 43 | 1119 | 834 | -285 |
| 8 | 2002 | 1076 | 48 | 1124 | 980 | -144 |
| 9 | 2003 | 1076 | 53 | 1129 | 1137 | 7 |
| 10 | 2004 | 1076 | 58 | 1134 | 1302 | 168 |
| 11 | 2005 | 648 | 61 | 709 | 1419 | 710 |
| 12 | 2006 | 578 | 64 | 642 | 1541 | 898 |
| 13 | 2007 | 578 | 67 | 645 | 1667 | 1022 |
| 14 | 2008 | 578 | 69 | 648 | 1799 | 1151 |
| 15 | 2009 | 578 | 72 | 651 | 1936 | 1285 |
| 16 | 2010 | 666 | 72 | 739 | 2001 | 1262 |
| 17 | 2011 | 27 | 72 | 99 | 2066 | 1966 |
| 18 | 2012 | 27 | 72 | 99 | 2131 | 2032 |
| 19 | 2013 | 27 | 72 | 99 | 2196 | 2097 |
| 20 | 2014 | 27 | 72 | 99 | 2261 | 2162 |
| 21 | 2015 | 666 | 72 | 739 | 2326 | 1588 |
| 22 | 2016 | 27 | 72 | 99 | 2392 | 2292 |
| 23 | 2017 | 27 | 72 | 99 | 2457 | 2357 |
| 24 | 2018 | 27 | 72 | 99 | 2522 | 2423 |
| 25 | 2019 | 27 | 72 | 99 | 2587 | 2488 |
| 26 | 2020 | 666 | 72 | 739 | 2652 | 1914 |
| 27 | 2021 | 27 | 72 | 99 | 2717 | 2618 |
| 28 | 2022 | 27 | 72 | 99 | 2783 | 2683 |
| 29 | 2023 | 27 | 72 | 99 | 2848 | 2748 |
| 30 | 2024 | 27 | 72 | 99 | 2913 | 2813 |
| 31 | 2025 | 666 | 72 | 739 | 2978 | 2239 |
| 32 | 2026 | 27 | 72 | 99 | 3043 | 2944 |
| 33 | 2027 | 27 | 72 | 99 | 3108 | 3009 |
| 34 | 2028 | 27 | 72 | 99 | 3173 | 3074 |
| 35 | 2029 | 27 | 72 | 99 | 3239 | 3139 |
| 36 | 2030 | 666 | 72 | 739 | 3304 | 2565 |
| 37 | 2031 | 27 | 72 | 99 | 3369 | 3270 |
| 38 | 2032 | 27 | 72 | 99 | 3434 | 3335 |
| 39 | 2033 | 27 | 72 | 99 | 3499 | 3400 |
| 40 | 2034 | 27 | 72 | 99 | 3564 | 3465 |

Table L.7(2) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
SCF=Cash Flow (=BF - CS)

3. Greater Dhaka Projects Combined

(Unit:Tk Million)

| NO. | YEAR | CC | OM | CS | BF | CF |
|---|---|---|---|---|---|---|
| 1 | 1995 | 7006 | 27 | 7033 | 648 | -6385 |
| 2 | 1996 | 2053 | 37 | 2090 | 896 | -1194 |
| 3 | 1997 | 2053 | 48 | 2101 | 1167 | -934 |
| 4 | 1998 | 2053 | 58 | 2111 | 1461 | -650 |
| 5 | 1999 | 2053 | 68 | 2121 | 1781 | -340 |
| 6 | 2000 | 1604 | 75 | 1679 | 2038 | 359 |
| 7 | 2001 | 1496 | 83 | 1579 | 2312 | 733 |
| 8 | 2002 | 1496 | 90 | 1586 | 2600 | 1014 |
| 9 | 2003 | 1496 | 97 | 1593 | 2907 | 1314 |
| 10 | 2004 | 1496 | 104 | 1600 | 3228 | 1628 |
| 11 | 2005 | 658 | 107 | 765 | 3418 | 2653 |
| 12 | 2006 | 588 | 110 | 698 | 3614 | 2916 |
| 13 | 2007 | 588 | 113 | 701 | 3813 | 3112 |
| 14 | 2008 | 588 | 115 | 703 | 4019 | 3316 |
| 15 | 2009 | 588 | 118 | 706 | 4229 | 3523 |
| 16 | 2010 | 1074 | 118 | 1192 | 4367 | 3175 |
| 17 | 2011 | 37 | 118 | 155 | 4506 | 4351 |
| 18 | 2012 | 37 | 118 | 155 | 4644 | 4489 |
| 19 | 2013 | 37 | 118 | 155 | 4783 | 4628 |
| 20 | 2014 | 37 | 118 | 155 | 4921 | 4766 |
| 21 | 2015 | 1074 | 118 | 1192 | 5060 | 3868 |
| 22 | 2016 | 37 | 118 | 155 | 5199 | 5044 |
| 23 | 2017 | 37 | 118 | 155 | 5338 | 5183 |
| 24 | 2018 | 37 | 118 | 155 | 5476 | 5321 |
| 25 | 2019 | 37 | 118 | 155 | 5614 | 5459 |
| 26 | 2020 | 676 | 118 | 794 | 5753 | 4959 |
| 27 | 2021 | 37 | 118 | 155 | 5891 | 5736 |
| 28 | 2022 | 37 | 118 | 155 | 6031 | 5876 |
| 29 | 2023 | 37 | 118 | 155 | 6169 | 6014 |
| 30 | 2024 | 37 | 118 | 155 | 6308 | 6153 |
| 31 | 2025 | 1074 | 118 | 1192 | 6446 | 5254 |
| 32 | 2026 | 37 | 118 | 155 | 6585 | 6430 |
| 33 | 2027 | 37 | 118 | 155 | 6723 | 6568 |
| 34 | 2028 | 37 | 118 | 155 | 6862 | 6707 |
| 35 | 2029 | 37 | 118 | 155 | 7001 | 6846 |
| 36 | 2030 | 676 | 118 | 794 | 7066 | 6272 |
| 37 | 2031 | 37 | 118 | 155 | 7131 | 6976 |
| 38 | 2032 | 37 | 118 | 155 | 7196 | 7041 |
| 39 | 2033 | 37 | 118 | 155 | 7261 | 7106 |
| 40 | 2034 | 37 | 118 | 155 | 7326 | 7171 |

4. Narayanganj DND Project

(Unit:Tk Million)

| NO. | YEAR | CC | OM | CS | BF | CF |
|---|---|---|---|---|---|---|
| 1 | 1995 | 587 | 3 | 590 | 53 | -538 |
| 2 | 1996 | 469 | 5 | 475 | 100 | -374 |
| 3 | 1997 | 469 | 8 | 477 | 153 | -324 |
| 4 | 1998 | 250 | 9 | 259 | 187 | -72 |
| 5 | 1999 | 250 | 10 | 260 | 224 | -37 |
| 6 | 2000 | 255 | 11 | 266 | 263 | -3 |
| 7 | 2001 | 255 | 12 | 267 | 305 | 38 |
| 8 | 2002 | 255 | 14 | 268 | 349 | 81 |
| 9 | 2003 | 255 | 15 | 270 | 397 | 127 |
| 10 | 2004 | 255 | 16 | 271 | 446 | 175 |
| 11 | 2005 | 9 | 16 | 25 | 463 | 438 |
| 12 | 2006 | 9 | 16 | 25 | 481 | 455 |
| 13 | 2007 | 9 | 16 | 25 | 498 | 472 |
| 14 | 2008 | 9 | 16 | 25 | 515 | 490 |
| 15 | 2009 | 9 | 16 | 25 | 532 | 507 |
| 16 | 2010 | 582 | 16 | 598 | 549 | -49 |
| 17 | 2011 | 9 | 16 | 25 | 566 | 541 |
| 18 | 2012 | 9 | 16 | 25 | 583 | 558 |
| 19 | 2013 | 9 | 16 | 25 | 600 | 575 |
| 20 | 2014 | 9 | 16 | 25 | 617 | 592 |
| 21 | 2015 | 9 | 16 | 25 | 635 | 609 |
| 22 | 2016 | 9 | 16 | 25 | 652 | 626 |
| 23 | 2017 | 9 | 16 | 25 | 669 | 644 |
| 24 | 2018 | 9 | 16 | 25 | 686 | 661 |
| 25 | 2019 | 9 | 16 | 25 | 703 | 678 |
| 26 | 2020 | 9 | 16 | 25 | 720 | 695 |
| 27 | 2021 | 9 | 16 | 25 | 737 | 712 |
| 28 | 2022 | 9 | 16 | 25 | 754 | 729 |
| 29 | 2023 | 9 | 16 | 25 | 771 | 746 |
| 30 | 2024 | 9 | 16 | 25 | 789 | 763 |
| 31 | 2025 | 582 | 16 | 598 | 806 | 208 |
| 32 | 2026 | 9 | 16 | 25 | 823 | 798 |
| 33 | 2027 | 9 | 16 | 25 | 840 | 815 |
| 34 | 2028 | 9 | 16 | 25 | 857 | 832 |
| 35 | 2029 | 9 | 16 | 25 | 874 | 849 |

Table L.7(3) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
SCF=Cash Flow (=BF - CS)

5. Narayanganj West Project

(Unit:Tk Million)

| NO. | YEAR | CC | OM | CS | BF | CF |
|---|---|---|---|---|---|---|
| 1 | 1995 | 341 | 1 | 343 | 23 | -320 |
| 2 | 1996 | 285 | 3 | 288 | 50 | -237 |
| 3 | 1997 | 285 | 4 | 289 | 81 | -208 |
| 4 | 1998 | 285 | 6 | 291 | 117 | -174 |
| 5 | 1999 | 117 | 6 | 123 | 132 | 9 |
| 6 | 2000 | 117 | 6 | 124 | 148 | 25 |
| 7 | 2001 | 72 | 7 | 79 | 166 | 87 |
| 8 | 2002 | 72 | 7 | 79 | 184 | 105 |
| 9 | 2003 | 72 | 7 | 80 | 204 | 124 |
| 10 | 2004 | 72 | 8 | 80 | 224 | 144 |
| 11 | 2005 | 3 | 8 | 11 | 235 | 224 |
| 12 | 2006 | 3 | 8 | 11 | 245 | 235 |
| 13 | 2007 | 3 | 8 | 11 | 256 | 246 |
| 14 | 2008 | 3 | 8 | 11 | 267 | 256 |
| 15 | 2009 | 3 | 8 | 11 | 278 | 267 |
| 16 | 2010 | 107 | 8 | 115 | 288 | 174 |
| 17 | 2011 | 3 | 8 | 11 | 299 | 289 |
| 18 | 2012 | 3 | 8 | 11 | 310 | 299 |
| 19 | 2013 | 3 | 8 | 11 | 321 | 310 |
| 20 | 2014 | 3 | 8 | 11 | 331 | 321 |
| 21 | 2015 | 107 | 8 | 115 | 342 | 228 |
| 22 | 2016 | 3 | 8 | 11 | 353 | 342 |
| 23 | 2017 | 3 | 8 | 11 | 364 | 353 |
| 24 | 2018 | 3 | 8 | 11 | 374 | 364 |
| 25 | 2019 | 3 | 8 | 11 | 385 | 375 |
| 26 | 2020 | 3 | 8 | 11 | 396 | 385 |
| 27 | 2021 | 3 | 8 | 11 | 407 | 396 |
| 28 | 2022 | 3 | 8 | 11 | 417 | 407 |
| 29 | 2023 | 3 | 8 | 11 | 428 | 418 |
| 30 | 2024 | 3 | 8 | 11 | 439 | 428 |
| 31 | 2025 | 107 | 8 | 115 | 450 | 335 |
| 32 | 2026 | 3 | 8 | 11 | 460 | 450 |
| 33 | 2027 | 3 | 8 | 11 | 471 | 461 |
| 34 | 2028 | 3 | 8 | 11 | 482 | 471 |
| 35 | 2029 | 3 | 8 | 11 | 493 | 482 |

6. Narayanganj East Project

(Unit:Tk Million)

| NO. | YEAR | CC | OM | CS | BF | CF |
|---|---|---|---|---|---|---|
| 1 | 2005 | 552 | 2 | 554 | 28 | -526 |
| 2 | 2006 | 423 | 4 | 427 | 58 | -369 |
| 3 | 2007 | 423 | 6 | 430 | 90 | -339 |
| 4 | 2008 | 423 | 8 | 432 | 125 | -307 |
| 5 | 2009 | 423 | 11 | 434 | 161 | -273 |
| 6 | 2010 | 3 | 11 | 13 | 166 | 153 |
| 7 | 2011 | 3 | 11 | 13 | 172 | 158 |
| 8 | 2012 | 3 | 11 | 13 | 177 | 164 |
| 9 | 2013 | 3 | 11 | 13 | 182 | 169 |
| 10 | 2014 | 3 | 11 | 13 | 187 | 174 |
| 11 | 2015 | 3 | 11 | 13 | 193 | 179 |
| 12 | 2016 | 3 | 11 | 13 | 198 | 185 |
| 13 | 2017 | 3 | 11 | 13 | 203 | 190 |
| 14 | 2018 | 3 | 11 | 13 | 208 | 195 |
| 15 | 2019 | 3 | 11 | 13 | 214 | 200 |
| 16 | 2020 | 183 | 11 | 194 | 219 | 25 |
| 17 | 2021 | 3 | 11 | 13 | 224 | 211 |
| 18 | 2022 | 3 | 11 | 13 | 229 | 216 |
| 19 | 2023 | 3 | 11 | 13 | 235 | 221 |
| 20 | 2024 | 3 | 11 | 13 | 240 | 227 |
| 21 | 2025 | 3 | 11 | 13 | 245 | 232 |
| 22 | 2026 | 3 | 11 | 13 | 251 | 237 |
| 23 | 2027 | 3 | 11 | 13 | 256 | 242 |
| 24 | 2028 | 3 | 11 | 13 | 261 | 248 |
| 25 | 2029 | 3 | 11 | 13 | 266 | 253 |
| 26 | 2030 | 3 | 11 | 13 | 272 | 258 |
| 27 | 2031 | 3 | 11 | 13 | 277 | 264 |
| 28 | 2032 | 3 | 11 | 13 | 282 | 269 |
| 29 | 2033 | 3 | 11 | 13 | 287 | 274 |
| 30 | 2034 | 3 | 11 | 13 | 293 | 279 |

Table L.7(4) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
SCF=Cash Flow (=BF - CS)

7. Narayanganj Projects Combined

(Unit:Tk Million)

| NO. | YEAR | CC | OM | CS | BF | CF |
|---|---|---|---|---|---|---|
| 1 | 1995 | 928 | 4 | 932 | 76 | -856 |
| 2 | 1996 | 754 | 8 | 762 | 150 | -612 |
| 3 | 1997 | 754 | 12 | 766 | 234 | -532 |
| 4 | 1998 | 535 | 15 | 550 | 304 | -246 |
| 5 | 1999 | 367 | 16 | 383 | 356 | -27 |
| 6 | 2000 | 372 | 17 | 389 | 411 | 22 |
| 7 | 2001 | 327 | 19 | 346 | 471 | 125 |
| 8 | 2002 | 327 | 21 | 348 | 533 | 185 |
| 9 | 2003 | 327 | 22 | 349 | 601 | 252 |
| 10 | 2004 | 327 | 24 | 351 | 670 | 319 |
| 11 | 2005 | 564 | 26 | 590 | 726 | 136 |
| 12 | 2006 | 435 | 28 | 463 | 784 | 321 |
| 13 | 2007 | 435 | 30 | 465 | 844 | 379 |
| 14 | 2008 | 435 | 32 | 467 | 907 | 440 |
| 15 | 2009 | 435 | 35 | 470 | 971 | 501 |
| 16 | 2010 | 692 | 35 | 727 | 1003 | 276 |
| 17 | 2011 | 15 | 35 | 50 | 1037 | 987 |
| 18 | 2012 | 15 | 35 | 50 | 1070 | 1020 |
| 19 | 2013 | 15 | 35 | 50 | 1103 | 1053 |
| 20 | 2014 | 15 | 35 | 50 | 1135 | 1085 |
| 21 | 2015 | 119 | 35 | 154 | 1170 | 1016 |
| 22 | 2016 | 15 | 35 | 50 | 1203 | 1153 |
| 23 | 2017 | 15 | 35 | 50 | 1236 | 1186 |
| 24 | 2018 | 15 | 35 | 50 | 1268 | 1218 |
| 25 | 2019 | 15 | 35 | 50 | 1302 | 1252 |
| 26 | 2020 | 195 | 35 | 230 | 1335 | 1105 |
| 27 | 2021 | 15 | 35 | 50 | 1368 | 1318 |
| 28 | 2022 | 15 | 35 | 50 | 1400 | 1350 |
| 29 | 2023 | 15 | 35 | 50 | 1434 | 1384 |
| 30 | 2024 | 15 | 35 | 50 | 1468 | 1418 |
| 31 | 2025 | 692 | 35 | 727 | 1501 | 774 |
| 32 | 2026 | 15 | 35 | 50 | 1534 | 1484 |
| 33 | 2027 | 15 | 35 | 50 | 1567 | 1517 |
| 34 | 2028 | 15 | 35 | 50 | 1600 | 1550 |
| 35 | 2029 | 15 | 35 | 50 | 1633 | 1583 |
| 36 | 2030 | 15 | 35 | 50 | 1639 | 1589 |
| 37 | 2031 | 15 | 35 | 50 | 1644 | 1594 |
| 38 | 2032 | 15 | 35 | 50 | 1649 | 1599 |
| 39 | 2033 | 15 | 35 | 50 | 1654 | 1604 |
| 40 | 2034 | 15 | 35 | 50 | 1660 | 1610 |

8. Keraniganj Project

(Unit:Tk Million)

| NO. | YEAR | CC | OM | CS | BF | CF |
|---|---|---|---|---|---|---|
| 1 | 2000 | 768 | 3 | 771 | 50 | -721 |
| 2 | 2001 | 681 | 7 | 687 | 104 | -584 |
| 3 | 2002 | 681 | 10 | 691 | 162 | -529 |
| 4 | 2003 | 681 | 14 | 694 | 225 | -470 |
| 5 | 2004 | 681 | 17 | 698 | 291 | -406 |
| 6 | 2005 | 197 | 18 | 215 | 315 | 100 |
| 7 | 2006 | 146 | 18 | 165 | 339 | 174 |
| 8 | 2007 | 146 | 19 | 165 | 364 | 199 |
| 9 | 2008 | 146 | 20 | 166 | 390 | 224 |
| 10 | 2009 | 146 | 20 | 167 | 417 | 250 |
| 11 | 2010 | 6 | 20 | 26 | 430 | 404 |
| 12 | 2011 | 6 | 20 | 26 | 443 | 417 |
| 13 | 2012 | 6 | 20 | 26 | 456 | 430 |
| 14 | 2013 | 6 | 20 | 26 | 469 | 443 |
| 15 | 2014 | 6 | 20 | 26 | 482 | 456 |
| 16 | 2015 | 335 | 20 | 356 | 496 | 140 |
| 17 | 2016 | 6 | 20 | 26 | 509 | 482 |
| 18 | 2017 | 6 | 20 | 26 | 522 | 495 |
| 19 | 2018 | 6 | 20 | 26 | 535 | 508 |
| 20 | 2019 | 6 | 20 | 26 | 548 | 521 |
| 21 | 2020 | 6 | 20 | 26 | 561 | 534 |
| 22 | 2021 | 6 | 20 | 26 | 574 | 548 |
| 23 | 2022 | 6 | 20 | 26 | 587 | 561 |
| 24 | 2023 | 6 | 20 | 26 | 600 | 574 |
| 25 | 2024 | 6 | 20 | 26 | 613 | 587 |
| 26 | 2025 | 6 | 20 | 26 | 626 | 600 |
| 27 | 2026 | 6 | 20 | 26 | 639 | 613 |
| 28 | 2027 | 6 | 20 | 26 | 652 | 626 |
| 29 | 2028 | 6 | 20 | 26 | 665 | 639 |
| 30 | 2029 | 6 | 20 | 26 | 678 | 652 |
| 31 | 2030 | 335 | 20 | 356 | 691 | 336 |
| 32 | 2031 | 6 | 20 | 26 | 704 | 678 |
| 33 | 2032 | 6 | 20 | 26 | 717 | 691 |
| 34 | 2033 | 6 | 20 | 26 | 730 | 704 |
| 35 | 2034 | 6 | 20 | 26 | 743 | 717 |

Table L.7(5) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
SCF=Cash Flow (=BF - CS)

9. Savar Project

(Unit:Tk Million)

| NO. | YEAR | CC | OM | CS | BF | CF |
|---|---|---|---|---|---|---|
| 1 | 2005 | 531 | 2 | 533 | 10 | -523 |
| 2 | 2006 | 485 | 5 | 489 | 21 | -468 |
| 3 | 2007 | 485 | 7 | 492 | 33 | -459 |
| 4 | 2008 | 127 | 8 | 135 | 37 | -98 |
| 5 | 2009 | 127 | 9 | 136 | 42 | -94 |
| 6 | 2010 | 1 | 9 | 10 | 43 | 33 |
| 7 | 2011 | 1 | 9 | 10 | 45 | 35 |
| 8 | 2012 | 1 | 9 | 10 | 46 | 36 |
| 9 | 2013 | 1 | 9 | 10 | 48 | 38 |
| 10 | 2014 | 1 | 9 | 10 | 49 | 39 |
| 11 | 2015 | 1 | 9 | 10 | 51 | 41 |
| 12 | 2016 | 1 | 9 | 10 | 52 | 42 |
| 13 | 2017 | 1 | 9 | 10 | 54 | 44 |
| 14 | 2018 | 1 | 9 | 10 | 55 | 45 |
| 15 | 2019 | 1 | 9 | 10 | 57 | 47 |
| 16 | 2020 | 1 | 9 | 10 | 58 | 48 |
| 17 | 2021 | 1 | 9 | 10 | 60 | 50 |
| 18 | 2022 | 1 | 9 | 10 | 61 | 51 |
| 19 | 2023 | 1 | 9 | 10 | 63 | 53 |
| 20 | 2024 | 1 | 9 | 10 | 65 | 55 |
| 21 | 2025 | 1 | 9 | 10 | 66 | 56 |
| 22 | 2026 | 1 | 9 | 10 | 68 | 58 |
| 23 | 2027 | 1 | 9 | 10 | 69 | 59 |
| 24 | 2028 | 1 | 9 | 10 | 71 | 61 |
| 25 | 2029 | 1 | 9 | 10 | 72 | 62 |
| 26 | 2030 | 1 | 9 | 10 | 74 | 64 |
| 27 | 2031 | 1 | 9 | 10 | 75 | 65 |
| 28 | 2032 | 1 | 9 | 10 | 77 | 67 |
| 29 | 2033 | 1 | 9 | 10 | 78 | 68 |
| 30 | 2034 | 1 | 9 | 10 | 80 | 70 |

10. Tongi Project

(Unit:Tk Million)

| NO. | YEAR | CC | OM | CS | BF | CF |
|---|---|---|---|---|---|---|
| 1 | 2000 | 487 | 2 | 489 | 33 | -457 |
| 2 | 2001 | 463 | 5 | 467 | 70 | -398 |
| 3 | 2002 | 463 | 7 | 470 | 111 | -358 |
| 4 | 2003 | 463 | 9 | 472 | 157 | -314 |
| 5 | 2004 | 128 | 10 | 138 | 178 | 40 |
| 6 | 2005 | 148 | 10 | 159 | 199 | 41 |
| 7 | 2006 | 130 | 11 | 141 | 222 | 81 |
| 8 | 2007 | 130 | 12 | 141 | 246 | 105 |
| 9 | 2008 | 130 | 12 | 142 | 272 | 130 |
| 10 | 2009 | 130 | 13 | 143 | 298 | 156 |
| 11 | 2010 | 5 | 13 | 18 | 311 | 294 |
| 12 | 2011 | 5 | 13 | 18 | 324 | 306 |
| 13 | 2012 | 5 | 13 | 18 | 337 | 319 |
| 14 | 2013 | 5 | 13 | 18 | 350 | 332 |
| 15 | 2014 | 5 | 13 | 18 | 362 | 345 |
| 16 | 2015 | 151 | 13 | 164 | 375 | 211 |
| 17 | 2016 | 5 | 13 | 18 | 388 | 370 |
| 18 | 2017 | 5 | 13 | 18 | 401 | 383 |
| 19 | 2018 | 5 | 13 | 18 | 414 | 396 |
| 20 | 2019 | 5 | 13 | 18 | 426 | 409 |
| 21 | 2020 | 151 | 13 | 164 | 439 | 275 |
| 22 | 2021 | 5 | 13 | 18 | 452 | 434 |
| 23 | 2022 | 5 | 13 | 18 | 465 | 447 |
| 24 | 2023 | 5 | 13 | 18 | 478 | 460 |
| 25 | 2024 | 5 | 13 | 18 | 490 | 473 |
| 26 | 2025 | 5 | 13 | 18 | 503 | 486 |
| 27 | 2026 | 5 | 13 | 18 | 516 | 498 |
| 28 | 2027 | 5 | 13 | 18 | 529 | 511 |
| 29 | 2028 | 5 | 13 | 18 | 542 | 524 |
| 30 | 2029 | 5 | 13 | 18 | 554 | 537 |
| 31 | 2030 | 151 | 13 | 164 | 567 | 403 |
| 32 | 2031 | 5 | 13 | 18 | 580 | 562 |
| 33 | 2032 | 5 | 13 | 18 | 593 | 575 |
| 34 | 2033 | 5 | 13 | 18 | 606 | 588 |
| 35 | 2034 | 5 | 13 | 18 | 618 | 601 |

Table L.7(6) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
SCF=Cash Flow (=BF - CS)

11. Eight Projects Combined

(Unit:Tk Million)

| NO. | YEAR | CC | OM | CS | BF | CF |
|---|---|---|---|---|---|---|
| 1 | 1995 | 7934 | 31 | 7965 | 724 | -7241 |
| 2 | 1996 | 2807 | 45 | 2852 | 1046 | -1806 |
| 3 | 1997 | 2807 | 60 | 2867 | 1401 | -1466 |
| 4 | 1998 | 2588 | 73 | 2661 | 1765 | -896 |
| 5 | 1999 | 2420 | 84 | 2504 | 2137 | -367 |
| 6 | 2000 | 3231 | 97 | 3328 | 2532 | -796 |
| 7 | 2001 | 2967 | 114 | 3081 | 2957 | -124 |
| 8 | 2002 | 2967 | 128 | 3095 | 3406 | 311 |
| 9 | 2003 | 2967 | 142 | 3109 | 3890 | 781 |
| 10 | 2004 | 2632 | 155 | 2787 | 4367 | 1580 |
| 11 | 2005 | 2098 | 163 | 2261 | 4668 | 2407 |
| 12 | 2006 | 1784 | 172 | 1956 | 4980 | 3024 |
| 13 | 2007 | 1784 | 181 | 1965 | 5300 | 3335 |
| 14 | 2008 | 1426 | 187 | 1613 | 5625 | 4012 |
| 15 | 2009 | 1426 | 195 | 1621 | 5957 | 4336 |
| 16 | 2010 | 1778 | 195 | 1973 | 6154 | 4181 |
| 17 | 2011 | 64 | 195 | 259 | 6355 | 6096 |
| 18 | 2012 | 64 | 195 | 259 | 6553 | 6294 |
| 19 | 2013 | 64 | 195 | 259 | 6753 | 6494 |
| 20 | 2014 | 64 | 195 | 259 | 6949 | 6690 |
| 21 | 2015 | 1680 | 195 | 1875 | 7152 | 5277 |
| 22 | 2016 | 64 | 195 | 259 | 7351 | 7092 |
| 23 | 2017 | 64 | 195 | 259 | 7551 | 7292 |
| 24 | 2018 | 64 | 195 | 259 | 7748 | 7489 |
| 25 | 2019 | 64 | 195 | 259 | 7947 | 7688 |
| 26 | 2020 | 1029 | 195 | 1224 | 8146 | 6922 |
| 27 | 2021 | 64 | 195 | 259 | 8345 | 8086 |
| 28 | 2022 | 64 | 195 | 259 | 8544 | 8285 |
| 29 | 2023 | 64 | 195 | 259 | 8744 | 8485 |
| 30 | 2024 | 64 | 195 | 259 | 8944 | 8685 |
| 31 | 2025 | 1778 | 195 | 1973 | 9142 | 7169 |
| 32 | 2026 | 64 | 195 | 259 | 9342 | 9083 |
| 33 | 2027 | 64 | 195 | 259 | 9540 | 9281 |
| 34 | 2028 | 64 | 195 | 259 | 9740 | 9481 |
| 35 | 2029 | 64 | 195 | 259 | 9938 | 9679 |
| 36 | 2030 | 1178 | 195 | 1373 | 10037 | 8664 |
| 37 | 2031 | 64 | 195 | 259 | 10134 | 9875 |
| 38 | 2032 | 64 | 195 | 259 | 10232 | 9973 |
| 39 | 2033 | 64 | 195 | 259 | 10329 | 10070 |
| 40 | 2034 | 64 | 195 | 259 | 10427 | 10168 |

Table L.8 Summary of Results of Economic Analysis

| Project | EIRR (%) | NPV (Tk Million) | B/C |
|---|---|---|---|
| Greater Dhaka West | 18.3 | 4,433 | 1.52 |
| Greater Dhaka East | 12.3 | 149 | 1.02 |
| Greater Dhaka Combined | 15.3 | 4,570 | 1.27 |
| Narayanganj DND | 14.2 | 363 | 1.16 |
| Narayanganj West | 13.7 | 177 | 1.14 |
| Narayanganj East | 7.4 | -176 | 0.69 |
| Narayanganj Combined | 13.5 | 456 | 1.11 |
| Keraniganj | 10.0 | -263 | 0.85 |
| Savar | - | -351 | 0.23 |
| Tongi | 11.8 | -24 | 0.98 |
| TOTAL | 14.3 | 4,388 | 1.18 |

Note: OCC is assumed as 12%.

Source: JICA

Table L.9 Results of Sensitivity Analysis

(Unit: %)

| Project | EIRR | | |
|---|---|---|---|
| | Standard | Case I | Case II |
| Greater Dhaka West | 18.3 | 22.0 | 15.3 |
| Greater Dhaka East | 12.3 | 14.7 | 10.2 |
| Greater Dhaka Combined | 15.3 | 18.2 | 12.8 |
| Narayanganj DND | 14.2 | 17.2 | 11.6 |
| Narayanganj West | 13.7 | 16.4 | 11.5 |
| Narayanganj East | 7.4 | 9.5 | 5.5 |
| Narayanganj Combined | 13.5 | 16.3 | 11.1 |
| Keraniganj | 10.0 | 12.3 | 8.0 |
| Savar | - | - | - |
| Tongi | 11.8 | 14.2 | 9.7 |
| TOTAL | 14.3 | 17.2 | 11.9 |

Note: Case I ... Benefits: +20%, Costs: No Change
Case II ... Benefits: No Change, Costs: +20%

Source: JICA

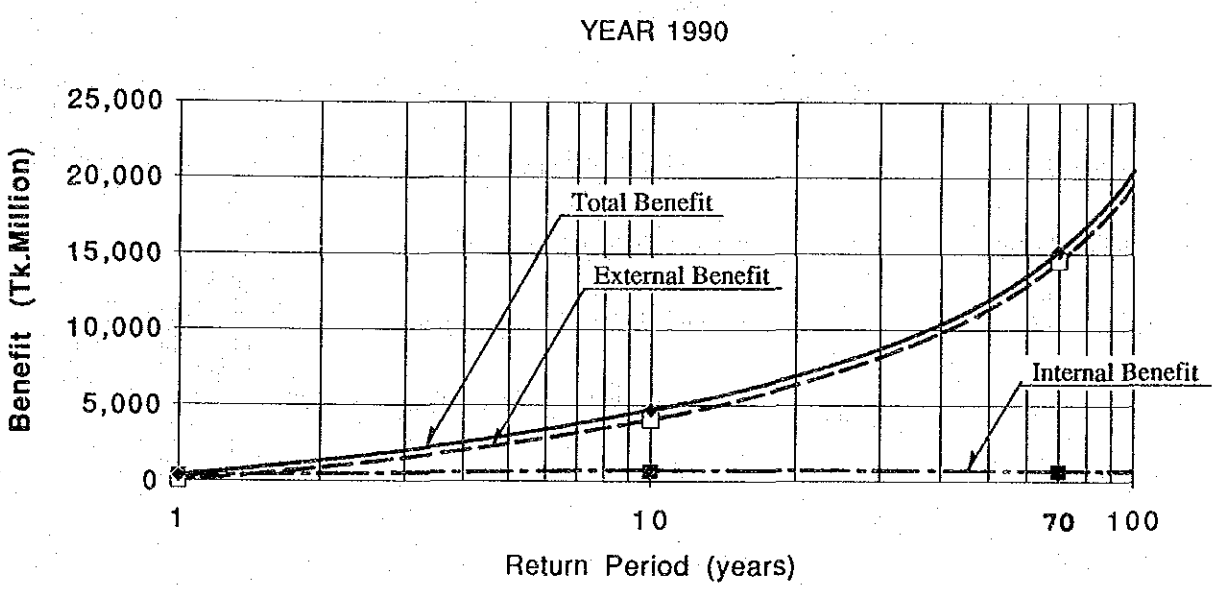
Table L.10 Rankings of Projects

| Item | Greater Dhaka | | Narayanganj | | | Kerani-ganj | Savar | Tongi |
|---|---|---|---|---|---|---|---|---|
| | West | East | DND | West | East | | | |
| EIRR (%) | 18.3 | 12.3 | 14.2 | 13.7 | 7.4 | 10.0 | - | 11.8 |
| | 15.3 | | | 13.5 | | | | |
| Built-up Area in 1990 (km2) | 50.6 | 68.6 | 21.7 | 13.1 | 7.5 | 7.4 | 20.6 | 10.3 |
| Population in 1990 (million) | 2.26 | 2.18 | 0.45 | 0.47 | 0.13 | 0.22 | 0.13 | 0.14 |
| Population Density in 1990 (pop./ha) | 447 | 317 | 207 | 359 | 175 | 298 | 63 | 134 |
| Area to be newly developed by 2010 (km2) | 29.8 | 61.5 | 21.0 | 4.1 | 4.0 | 12.7 | 24.5 | 9.1 |
| Population in 2010 (million) | 4.09 | 4.50 | 1.31 | 0.93 | 0.27 | 0.46 | 0.41 | 0.65 |
| Population Density in 2010 (pop./ha) | 508 | 346 | 307 | 539 | 232 | 228 | 91 | 235 |
| Economic Efficiency | A | A | A | A | C | B | C | B |
| Social Impact | A | A | B | A | C | B | C | B |
| Future Social Impact | A | A | A | B | C | B | C | B |
| Overall Priority | A | A | A | A | C | B | C | B |

Source: JICA

**Return Period and Benefit** (unit : Tk. Million)

| Return Period (Years) | 1990 Benefit | | | 2010 Benefit | | |
|---|---|---|---|---|---|---|
| | Internal | External | Total | Internal | External | Total |
| 1 | 312.4 | - | 312.4 | 600.1 | - | 600.1 |
| 10 | 663.9 | 4,058.7 | 4,722.6 | 1,239.4 | 12,237.8 | 13,477.2 |
| 70 | 663.9 | 14,504.1 | 15,168.0 | 1,239.4 | 45,107.6 | 46,347.0 |



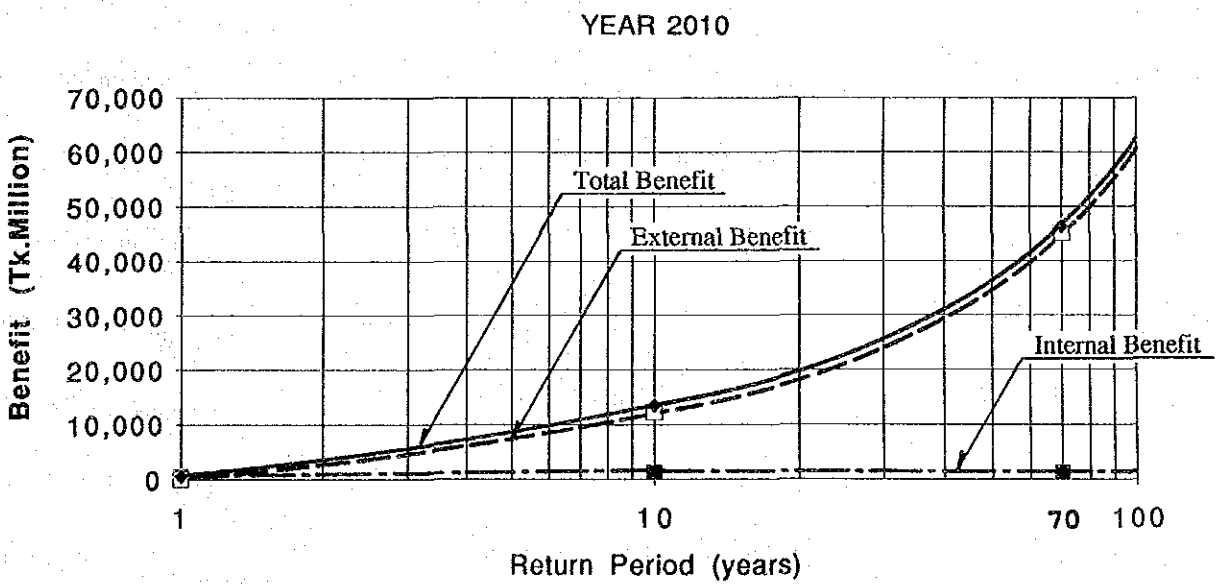




**FIG. L.1** SUMMARIZED BENEFITS-RETURN PERIOD CURVE