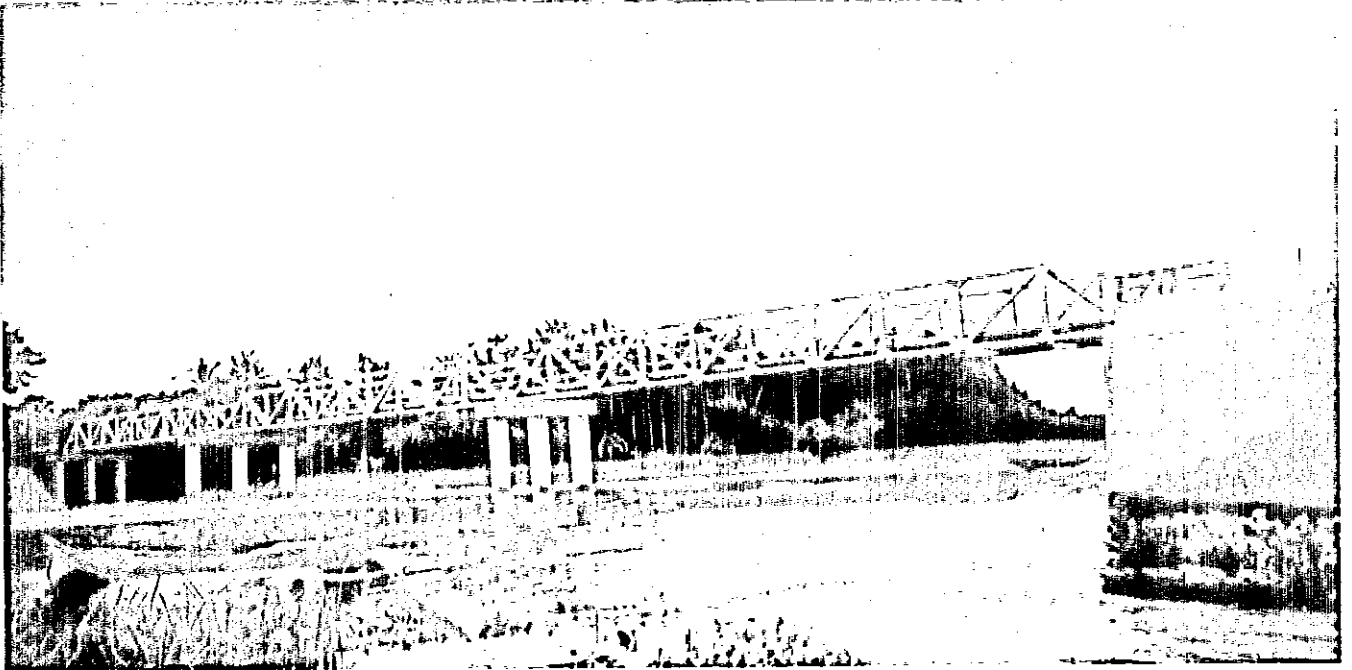


People's Republic of Bangladesh

Master Plan Study for Portable Steel Bridge Construction on Feeder and Rural Roads in Bangladesh

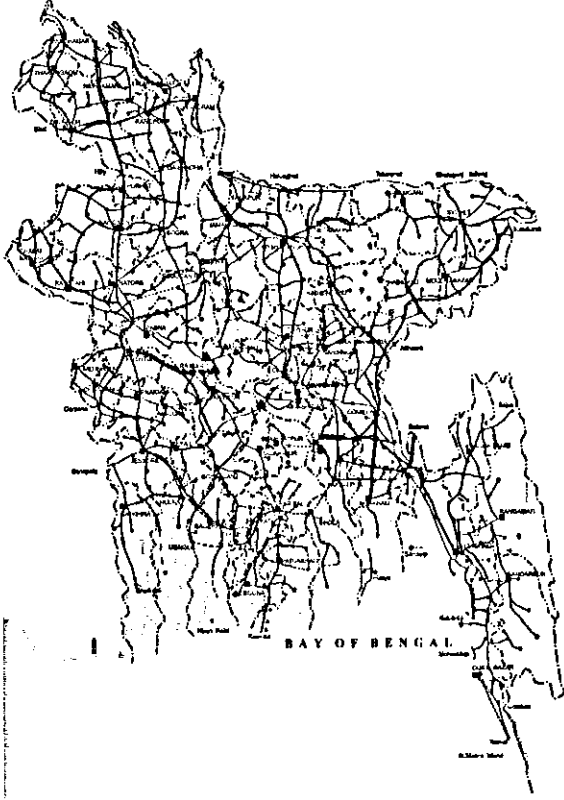
Final Report

Volume I of VI
Executive Summary



Prepared on behalf of

**Japan International Cooperation Agency
and
Local Government Engineering Department**



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Prepared By:
BCL Bangladesh Consultants Ltd.

October 2002

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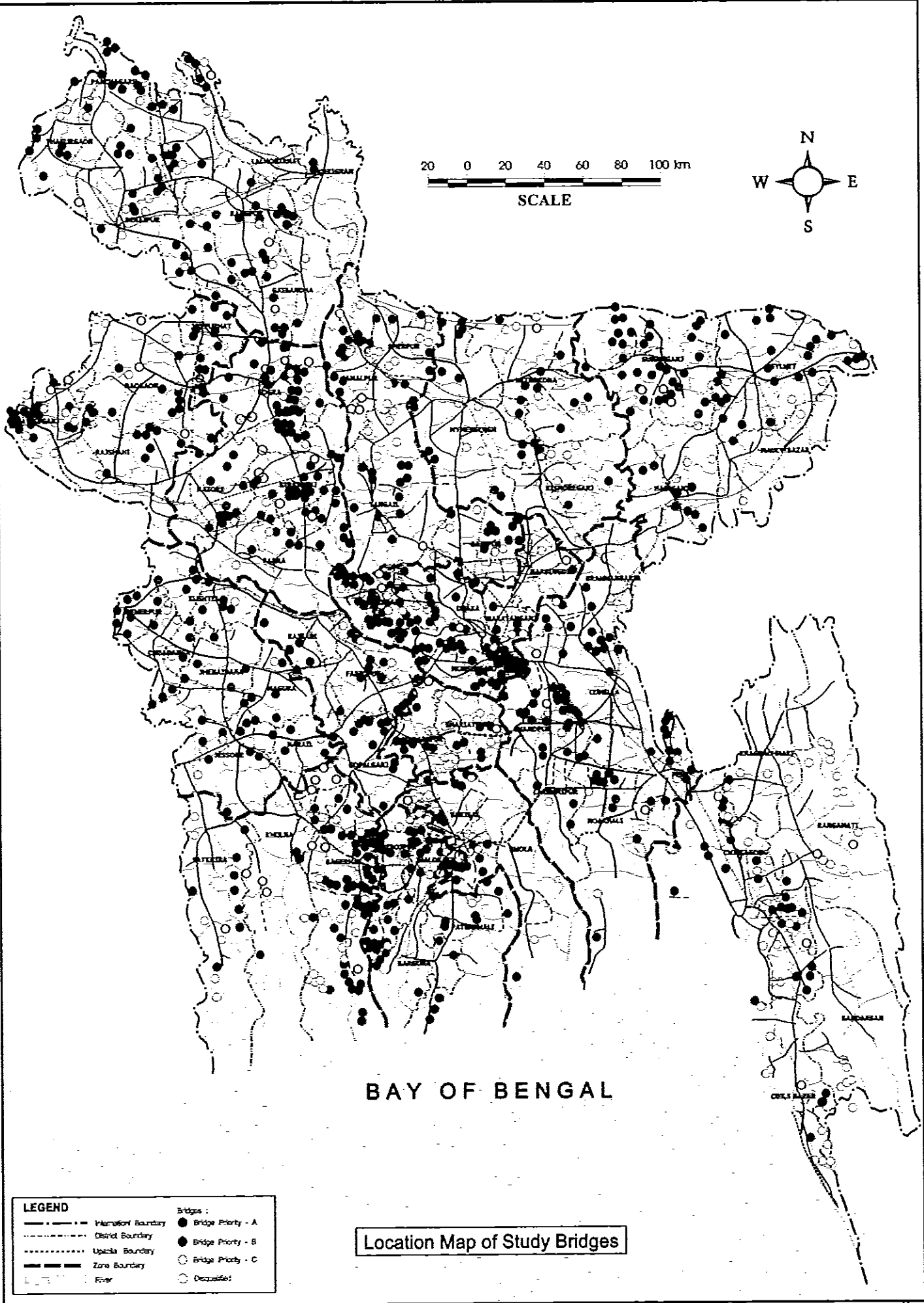
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BAY OF BENGAL

Location Map of Study Bridges

LEGEND	
— — — — —	International Boundary
— · — · — · —	District Boundary
— · — · — · —	Upazila Boundary
— — — — —	Zone Boundary
— — — — —	River
●	Bridge Priority - A
●	Bridge Priority - B
○	Bridge Priority - C
○	Declassified

1 INTRODUCTION

Background

In Bangladesh, about 80% of the population lives in rural areas, where the generation of employment opportunities does not catch up the population growth, resulting in abject poverty and high rate of un- and under-employment rate. Furthermore, the flood causes extensive damage almost every year to road structures and many road sections are impassable during rainy season, causing a serious constraint to rural development. The road sector has been playing a dominant role in the transport system in Bangladesh. However, the rural roads are still undeveloped and cannot ensure all weather year-round transport in many areas due to the lack of bridges crossing numerous rivers and canals. A large number of bridges need to be constructed/reconstructed urgently in the rural areas. In order to pursue the systematic implementation of the bridge construction for rural development purposes, it is of urgent necessity to investigate the present condition of the bridges and formulate a master plan. Under such situation, Japan International Cooperation Agency conducted the Master Plan Study for Portable Steel Bridge Construction on Feeder and Rural Roads in Bangladesh, in response to the request of the Government of Bangladesh through LGED.

Objectives of the Study

- to obtain basic data and information on the bridges needing construction/reconstruction on feeder and rural roads;
- to formulate a master plan for portable steel bridge construction on feeder and rural roads; and
- to assess the impacts of the construction of bridges in the priority zones and to formulate an investment plan thereof.

Scope of the Study

1. Preparation of location map of study bridges.
2. Division of the country into zones.
3. Collection of socio-economic data by zone.
4. Collection of information of relevant projects.
5. Evaluation of zones on effect and urgency of bridge construction.
6. Request to LGED local offices for providing basic data of study bridges.
7. Collection of basic data of study bridges and spot check.
8. Study on fund availability and implementation system
9. Formulation of master plan for portable steel bridge construction.
10. Selection of priority zones.
11. Site survey of project bridges in the priority zones.
12. Formulation of investment plan for project bridges in the priority zones.
13. Assessment of project effects.

2 DIVISION OF THE COUNTRY INTO ZONES

In consideration of geographical, socioeconomic and road developmental conditions and economic connection between neighboring districts, the country is divided into 15 zones as unit for analysis of socioeconomic condition and evaluation of urgency of bridge construction.

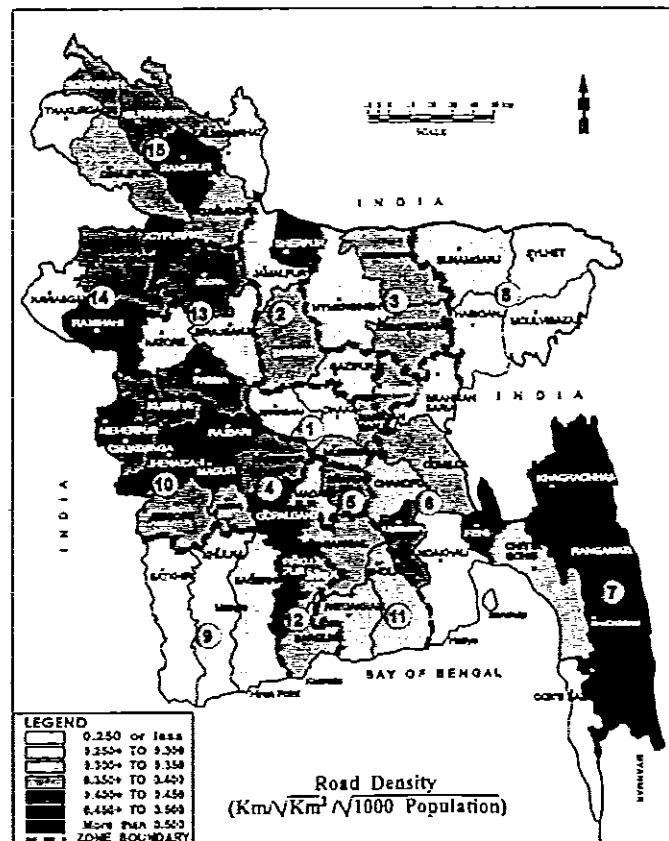
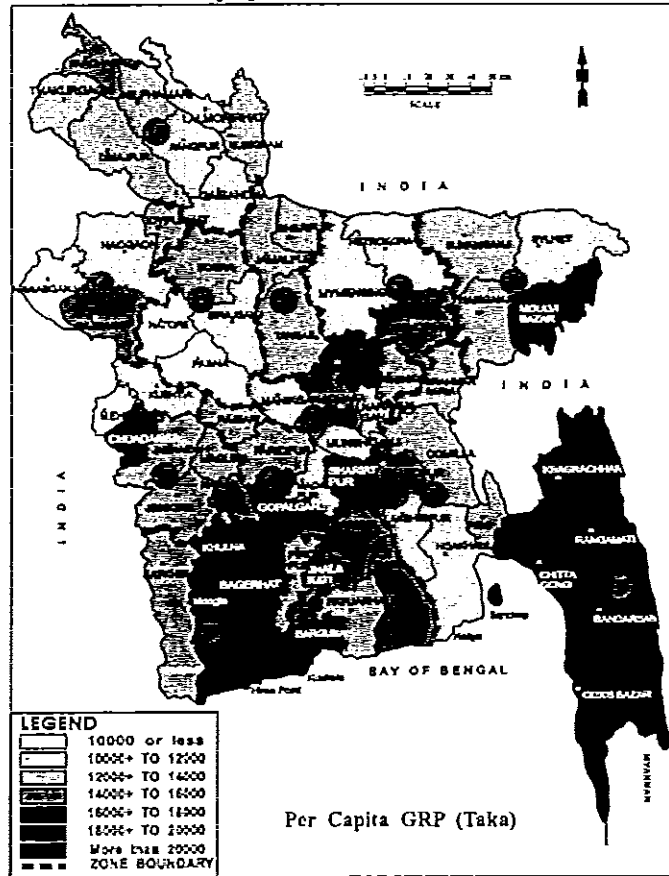


3 SOCIOECONOMIC CHARACTERISTICS OF ZONES

Zone	General	Demographic Characteristics	Economical Characteristics	Social Characteristics	Road Development Condition
1	<ul style="list-style-type: none"> Capital located Center of commerce and government Low and flat terrain 	<ul style="list-style-type: none"> Population density highest 	<ul style="list-style-type: none"> Per capita GRP close to average (Agricultural sector lowest, Industrial sector second highest, Service sector slightly higher than average) Land productivity highest 	<ul style="list-style-type: none"> Incidence of poverty second lowest Public facility ratio and growth center ratio per population lowest but those per land area highest 	<ul style="list-style-type: none"> Road density per area high Road density per area & population low
2	<ul style="list-style-type: none"> Close to the capital with good road link Mostly flat land Jamuna bridge located 	<ul style="list-style-type: none"> Population density third highest 	<ul style="list-style-type: none"> Per capita GRP close to average (Agricultural sector below average, Industrial sector above average, Service sector below average) Land productivity above average 	<ul style="list-style-type: none"> Incidence of poverty third highest Public facility ratio second lowest Growth center ratio third lowest 	<ul style="list-style-type: none"> Road density per area average Road density per area and population average
3	<ul style="list-style-type: none"> Close to capital Most of land low and flood prone 	<ul style="list-style-type: none"> Population density above average 	<ul style="list-style-type: none"> Per capita GRP below average (Agricultural sector close to average, Industrial & Service sectors low) Land productivity close to average 	<ul style="list-style-type: none"> Incidence of poverty medium Public facility ratio below average Growth center ratio average 	<ul style="list-style-type: none"> Road density per area average Road density per area & population average
4	<ul style="list-style-type: none"> High Incidence of flood 	<ul style="list-style-type: none"> Population density below average 	<ul style="list-style-type: none"> Per capita GRP below average in all sectors except in Service sector (slightly above average) Land productivity below average 	<ul style="list-style-type: none"> Incidence of poverty medium Public facility ratio highest Growth center ratio second highest 	<ul style="list-style-type: none"> Road density per area: Nat'l+Reg'l +Feeder-A+B highest, all road average Road density per area & population: same as above
5	<ul style="list-style-type: none"> Close to capital Means of communication to Dhaka mainly waterway 	<ul style="list-style-type: none"> Population density above average 	<ul style="list-style-type: none"> Per capita GRP slightly above average (Agricultural & Industrial sectors low, Service sector second highest) Land productivity fourth highest 	<ul style="list-style-type: none"> Incidence of poverty medium Public facility ratio second highest Growth center ratio third highest 	<ul style="list-style-type: none"> Road density per area above average Road density per area & population above average
6	<ul style="list-style-type: none"> Partly highland Partly hilly Partly flood prone Partly siltation area Small islands located 	<ul style="list-style-type: none"> Population density second highest 	<ul style="list-style-type: none"> Per capita GRP below average (Agricultural & Industrial sectors low, Service sector slightly above average) Land productivity second highest 	<ul style="list-style-type: none"> Incidence of poverty medium Public facility ratio third lowest Growth center ratio second lowest 	<ul style="list-style-type: none"> Road density per area above average Road density per area & population close to average
7	<ul style="list-style-type: none"> Mostly hilly area Flood free area Main sea port of the country located Commercial capital of the country 	<ul style="list-style-type: none"> Population density lowest Highest rate of tribal people 	<ul style="list-style-type: none"> Per capita GRP highest in all sectors Land productivity slightly below average 	<ul style="list-style-type: none"> Incidence of poverty lowest Public facility ratio below average Growth center ratio average 	<ul style="list-style-type: none"> Road density per area low Road density per area & population: close to average
8	<ul style="list-style-type: none"> Mixture of hills and depressed land Partly flood prone Tea producing district 	<ul style="list-style-type: none"> Population density below average High rate of tribal people (third highest) 	<ul style="list-style-type: none"> Per capita GRP close to average in all sectors Land productivity third lowest 	<ul style="list-style-type: none"> Incidence of poverty medium Public facility ratio and Growth center ratio above average 	<ul style="list-style-type: none"> Road density per area low Road density per area & population lowest

Zone	General	Demographic Characteristics	Economical Characteristics	Social Characteristics	Road Development Condition
9	<ul style="list-style-type: none"> • Biggest mangrove forest located • Mostly flood area • Tidal surge prone • Shrimp producing area 	<ul style="list-style-type: none"> • Population density second lowest 	<ul style="list-style-type: none"> • Per Capita GRP second highest (all sectors above average) • Land productivity lowest 	<ul style="list-style-type: none"> • Incidence of poverty third lowest • Public facility ratio and Growth center ratio above average 	<ul style="list-style-type: none"> • Road density per area lowest • Road density per area & population low
10	<ul style="list-style-type: none"> • Flat plain • Seasonal flood • Biggest irrigation project located 	<ul style="list-style-type: none"> • Population density slightly above average 	<ul style="list-style-type: none"> • Per capita GRP below average (Agricultural sector high, Industrial & Service sectors low) • Land productivity close to average 	<ul style="list-style-type: none"> • Incidence of poverty medium • Public facility ratio below average • Growth center ratio slightly above average 	<ul style="list-style-type: none"> • Road density per area high • Road density per area & population: same as above
11	<ul style="list-style-type: none"> • Flat plain • Predominantly riverline area • Partly tidal surge 	<ul style="list-style-type: none"> • Population density below average 	<ul style="list-style-type: none"> • Per capita GRP third highest (Agricultural & Service sectors high, Industrial sector low) • Land productivity low 	<ul style="list-style-type: none"> • Incidence of poverty medium • Public facility ratio & Growth center ratio above average 	<ul style="list-style-type: none"> • Road density per area: Nat'l + Reg'l + Feeder-A+B low, all road above average • Road density per area & population: Nat'l + Reg'l + Feeder-A+B average, all road second highest
12	<ul style="list-style-type: none"> • Mostly riverline area (highest river density in the country) • Partly tidal surge 	<ul style="list-style-type: none"> • Population density third lowest 	<ul style="list-style-type: none"> • Per capita GRP close to average (Agricultural sector high, Industrial sector low, Service sector average) • Land productivity second lowest 	<ul style="list-style-type: none"> • Incidence of poverty second highest • Public facility ratio third highest • Growth center ratio highest 	<ul style="list-style-type: none"> • Road density per area: Nat'l + Reg'l + Feeder-A+B average, all road highest • Road density per area & population: Nat'l + Reg'l + Feeder-A+B above average, all road highest
13	<ul style="list-style-type: none"> • Biggest depressed area (Chalanbeal) 	<ul style="list-style-type: none"> • Population density above average 	<ul style="list-style-type: none"> • Per capita GRP lowest (Agricultural sector low, Industrial sector low, Service sector lowest) • Land productivity low 	<ul style="list-style-type: none"> • Incidence of poverty fourth highest • Public facility ratio & Growth center ratio close to average 	<ul style="list-style-type: none"> • Road density per area close to average • Road density per area & population same as above
14	<ul style="list-style-type: none"> • Mostly flat land • Archaeologically important (Mohasthanagar) 	<ul style="list-style-type: none"> • Population density below average • High rate of tribal people (second highest) 	<ul style="list-style-type: none"> • Per capita GRP third lowest (all sectors below average) • Land productivity low 	<ul style="list-style-type: none"> • Incidence of poverty average • Public facility ratio & Growth center ratio close to average 	<ul style="list-style-type: none"> • Road density per area: Nat'l + Reg'l + Feeder-A+B above average, all road average • Road density per area & population: same as above
15	<ul style="list-style-type: none"> • Flat plain area • Stone chips available • Mining resources located 	<ul style="list-style-type: none"> • Population density close to national average 	<ul style="list-style-type: none"> • Per capita GRP second lowest (Agricultural sector above average, Industrial sector third lowest, Service sector second lowest) • Land productivity low 	<ul style="list-style-type: none"> • Incidence of poverty highest • Public facility ratio & Growth center ratio above average 	<ul style="list-style-type: none"> • Road density per area above average • Road density per area & population same as above

District-wise per capita GRP and road density are shown below, where the road density is defined as total length of National Highways, Regional Highways and Feeder Roads-A and B divided by square root of land area times population.

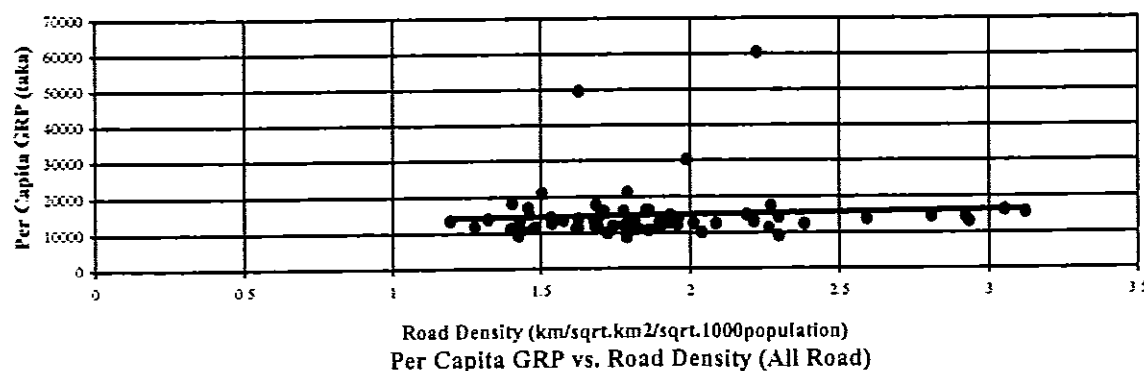
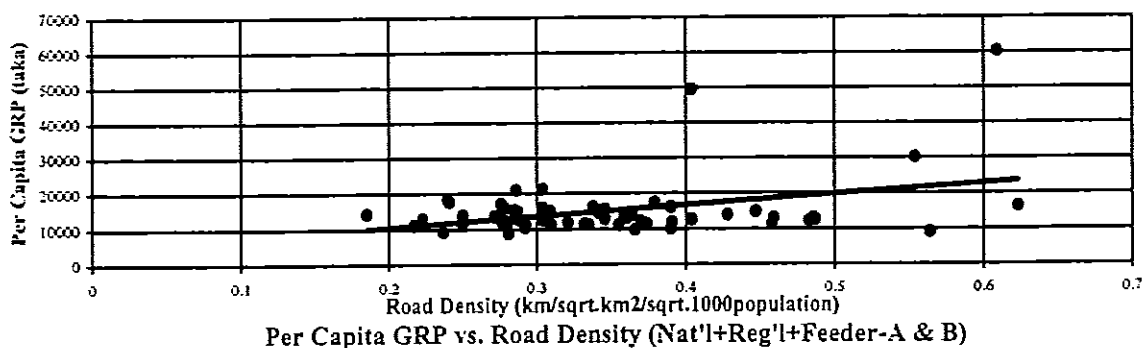
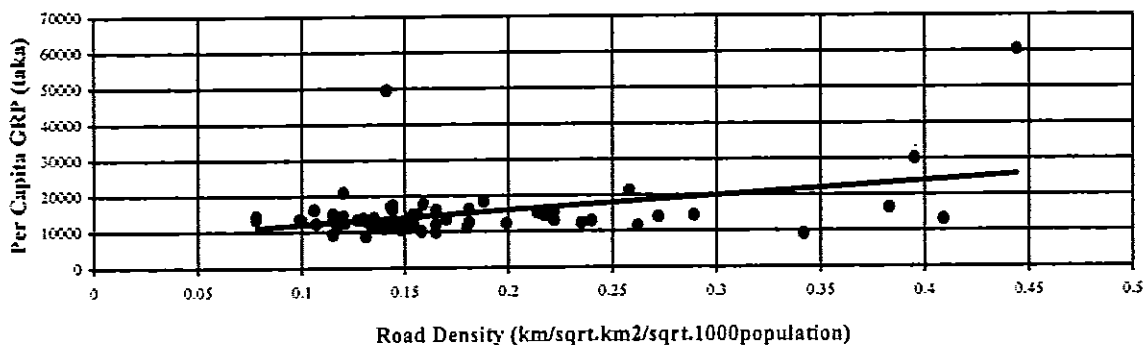


4 ASSESSMENT OF IMPACT OF BRIDGE CONSTRUCTION ON RURAL DEVELOPMENT

The relations of per capita GRP vs. road density is shown below in three cases of roads considered, viz.

- (1) National Highway + Regional Highway + Feeder Road-A,
- (2) National Highway + Regional Highway + Feeder Road-A&B, and
- (3) All roads.

Per capita GRP is correlated to some extent to road density in cases (1) and (2), but not in case (3). This is interpreted as the per capita GRP is related to development of higher class of road but not to lower class of road, suggesting the significance of road quality since the higher class of road is of higher quality in general. One of the determinant factors affecting the quality of road is the all weather passability. To make a road passable all year round, construction of bridge is essential for the gap without structure. Thus the road improvement through the construction of bridge will have a positive impact on economic development.

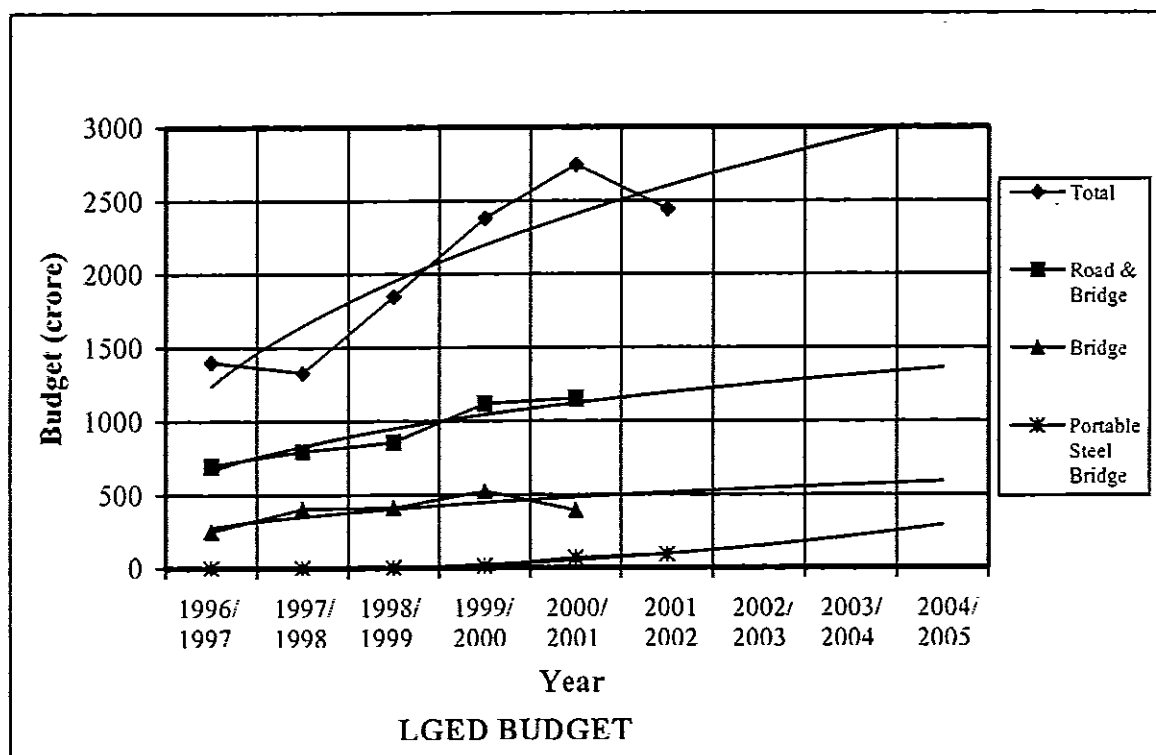


5 FUND AVAILABILITY

The LGED Budget in last five years are as follows:

(Crore Taka)				
Year	Total Budget (Infrastructure Development)	Budget for Road & Bridge Construction (A)	Budget for Bridge Construction (B)	Budget for Portable Steel Bridge Construction (C)
1996-1997	1,398.12	694.05	248.72	0
1997-1998	1,327.78	796.96	405.54	0
1998-1999	1,848.43	860.03	411.19	0.29
1999-2000	2,381.92	1,117.60	522.90	10.31
2000-2001	2,743.14	1,153.59	392.05	67.83
2001-2002	2,442.64			88.44

Note : B is a part of A. C is a part of B.



Based on the trend of its growth, the budget in 2003/2004 which is the first year of the master plan is estimated as follows:

Total budget	:	2,900 crore
Budget for road and bridge construction	:	1,300 crore
Budget for bridge construction	:	600 crore
Budget for portable steel bridge construction:		200 crore

Considering the possibility of future increase in budget, the possible investment amount for portable steel bridge construction projects is assumed to be 170 to 200 crore per year in this study.

6 IMPLEMENTATION SYSTEM FOR PORTABLE STEEL BRIDGE CONSTRUCTION

The problems faced in the process of implementation of the portable steel bridge construction project and the recommendations for improvement are as follows:

Identification of Problems in the System	Recommendations for Improvement
Allocation of GoB funds are found inadequate to cover the local expenses.	Allocation of local fund should be increased proportionately to the programme.
The package for procurement of steel materials for superstructure is of small volume which increases cost and time for implementation.	The package for procurement of steel materials for super structure should be of bigger volume.
The grant financing does not include any provision for logistic support i.e. vehicles for supervision, equipment for transportation of steel materials, etc.	It is desirable that the grant financing includes (a) vehicle for supervision i.e. jeep, pick-up & motorcycle etc. and (b) equipment for transportation of steel materials i.e. 6-wheeler truck.
Processing of project implementation takes time, which causes some of the listed bridges to be completed by other projects.	Processing of project implementation should be faster.
For decision of bridge length and preparation of design of foundation, no adequate hydrological investigation is done resulting in riverbank erosion and sometimes subsequent addition of the bridge length.	Proper hydrological investigation should be done for final decision of bridge length.
Additional technical and support staff is required at the LGED Head Office, but the staff cannot be increased due to financial constraints of local fund.	For better project implementation, Head Office staff should be increased.
Due to financial constraints of local funding, the input of the local consultants engaged by LGED are very small. As a result, adequate supervision by the consultant cannot be made.	The local consultant should have the responsibility for full time supervision to ensure quality and timely completion of works. Therefore, local consultant's input should be increased.
The rates of the items in the contract for local transportation and erection of superstructure are fixed, but at many occasions the works are spilled over 2 or 3 years. In such case, the contractor sustains loss due to price escalation and becomes reluctant to implement the works.	There should be provision for price adjustment.
In some cases, the road leading to the bridge sites is very narrow and may not accommodate the transport for carrying the superstructure steel materials.	Depending on the site condition, the programme of work should be adjusted such as transportation of steel materials during the monsoon using river transport, and erection during the dry season.
The central stockyard of LGED is open without shed and there is no crane for handling of steel materials.	The central stockyard of LGED should be provided with shed for protection of steel materials. The stockyard should also be equipped with crane(s) for handling of steel materials.
In case high navigation clearance is required, the height of abutment is remarkably high due to straight profile of superstructure resulting in high cost of abutment and approach road.	It is preferable to introduce longitudinal slope to reduce the height of abutment.

7 BASIC DATA OF STUDY BRIDGES

Total number of the study bridges is 1,152, consisting the following number of bridges by districts.

District	No.	District	No.	District	No.	District	No.	District	No.
<u>Zone-1</u>		<u>Zone-2</u>		<u>Zone-3</u>		<u>Zone-4</u>		<u>Zone-5</u>	
Dhaka	19	Gazipur	19	Mymensingh	22	Rajbari	5	Shariatpur	19
Narayanganj	15	Sherpur	16	Kishoreganj	6	Gopalganj	13	Madaripur	27
Munshiganj	30	Tangail	20	Netrakona	13	Faridpur	14		
Manikganj	56	Jamalpur	26						
Narsingdi	4								
Total	124	Total	81	Total	41	Total	32	Total	46

District	No.	District	No.	District	No.	District	No.	District	No.
<u>Zone-6</u>		<u>Zone-7</u>		<u>Zone-8</u>		<u>Zone-9</u>		<u>Zone-10</u>	
Comilla	17	Chittagong	45	Sylhet	31	Khulna	13	Jessore	14
B.Baria	6	Cox's Bazar	16	Moulvibazar	6	Bagerhat	59	Jhenaidah	7
Chandpur	26	Rangamati	16	Sunamganj	35	Satkhira	16	Magura	5
Feni	16	Khagrachhari	6	Habiganj	12			Kustia	10
Noakhali	18	Bandarban	8					Narail	8
Lakshmipur	4							Meherpur	7
								Chuadanga	9
Total	87	Total	91	Total	84	Total	88	Total	60

District	No.	District	No.	District	No.	District	No.	District	No.
<u>Zone-11</u>		<u>Zone-12</u>		<u>Zone-13</u>		<u>Zone-14</u>		<u>Zone-15</u>	
Barisal	61	Pirojpur	21	Natore	12	Rajshahi	8	Gaibandha	9
Bhola	2	Jhalakathi	30	Sirajganj	31	Nawabganj	28	Rangpur	19
		Barguna	13	Bogra	41	Joypurhat	10	Panchagar	14
		Patuakhali	17	Pabna	12	Naogaon	18	Dinajpur	31
								Thakurgaon	15
								Lalmonirhat	7
								Nilphamari	14
								Kurigram	5
Total	63	Total	81	Total	96	Total	64	Total	114

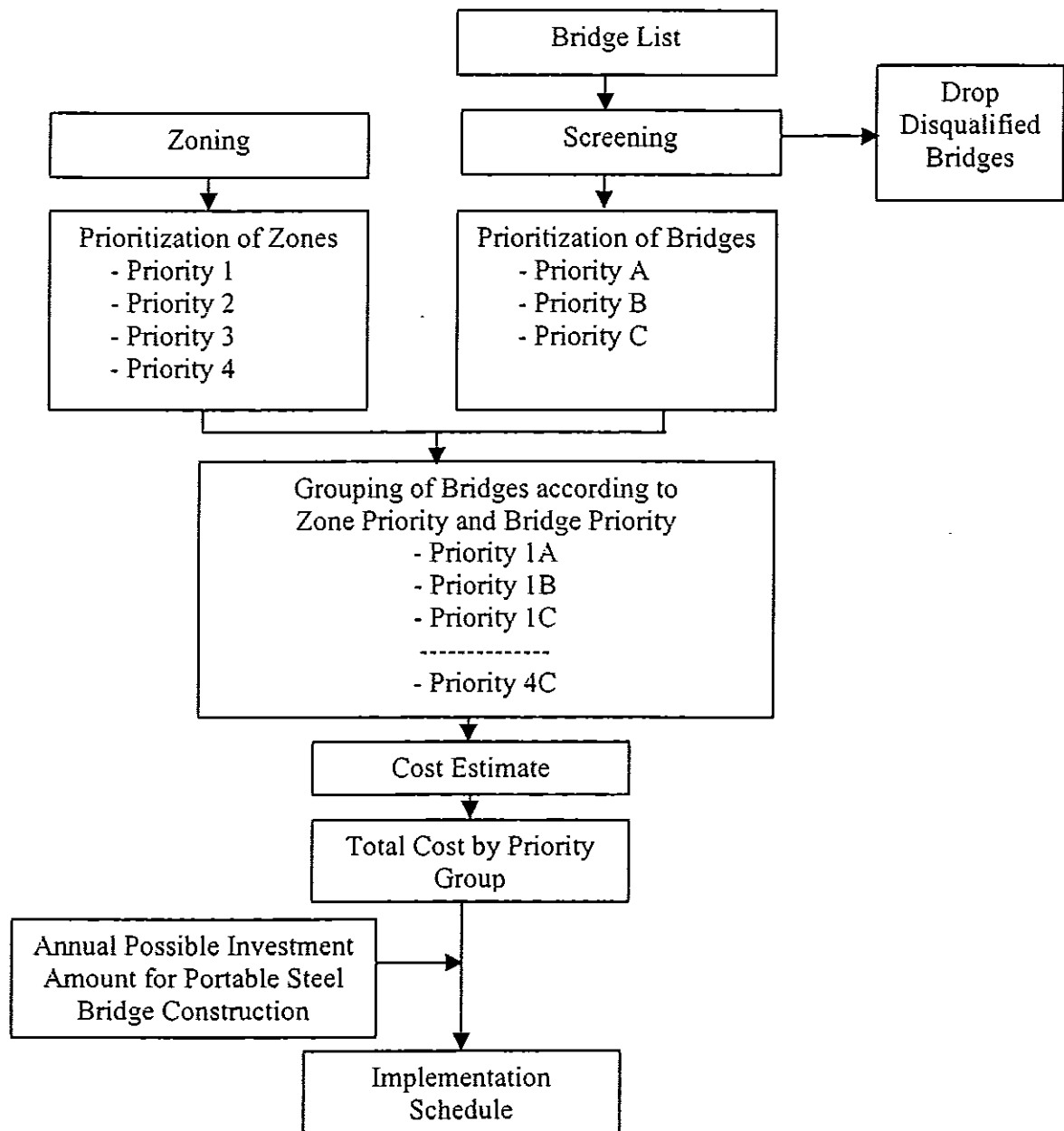
The Consultant Teams visited all the 64 districts and collected data from LGED district offices. The collected data are tabulated containing the following items:

- Project identification (bridge code, road ID)
- Information on existing bridge (existing or not, bridge type, usage of bridge, length, width, condition)
- Information on approach/connecting road (width, type, condition)
- Information on waterway (bank to bank width, dry season water depth, normal flood water depth)
- Socioeconomic information of influence area (population, main industry, major crop, number of public facilities)
- Expected traffic volume (truck/bus/car, rickshaw, bullock cart, pedestrian)
- Other information (length of alternative route, proposed bridge length, coverage by other project, relative priority according to LGED local offices).

8 MASTER PLAN FOR PORTABLE STEEL BRIDGE CONSTRUCTION

8.1 Procedure for Formulation of Master Plan

The country has been divided into 15 zones. The zones are prioritized and divided into four groups: priorities 1 to 4. On the other hand, the study bridges are screened first. The bridges which pass the screening criteria are called the project bridges. After screening, the project bridges are prioritized and divided into three groups: priorities A to C. Combining zone priority and bridge priority, the project bridges are divided into 12 groups. The combined priority is indicated such as 1A (zone priority 1 and bridge priority A), 1B, 1C and so forth. The implementation program is prepared by priority group.



Procedure for Formulation of Master Plan

8.2 Prioritization of Zones

Prioritization Criteria

The general objectives of the Project for Portable Steel Bridge Construction on Feeder and Rural Roads are summarized as follows:

- (1) promotion of economic development,
- (2) promotion of social development,
- (3) encouragement of road network development, and
- (4) support/promotion of other development projects.

Indicators for prioritization are selected in relation to the above objectives and the evaluation criteria are set as follows:

Factor	Indicator	Score*	Maximum Score
Economic Development	Agricultural Sector Share	12.5 X/A	25
	Per Capita GRP	12.5 A/X	25
	Land Productivity	12.5 A/X	25
	Unutilized Land Ratio	12.5 X/A	25
Social Development	Incidence of Poverty	25.0 X/A	50
	Public Facility Ratio	12.5 A/X	25
	Growth Center Ratio	12.5 A/X	25
Road Network Development	Road Density (Feeder-B & Rural)	25.0 X/A	50
	Study Bridges Ratio	25.0 X/A	50
Support of Development Projects	Effect of Supporting Development Projects	50.0 X/A	100

* X = value of indicator of zone, A = national average of indicator

Note: If calculated score exceeds the maximum score, the maximum score is applied.

Prioritization of Zones

Zone	Economic Dev't	Social Dev't	Road Network Dev't	Support of Dev't Projects	Total	Zone Priority
Zone 1	37.4	64.4	71.6	88.3	261.7	Priority 1
Zone 4	57.7	43.7	59.5	67.7	228.6	
Zone 13	48.7	54.9	54.0	69.8	227.4	
Zone 6	44.8	54.1	47.6	79.4	225.9	
Zone 10	50.2	49.1	43.9	81.8	225.0	Priority 2
Zone 9	59.7	43.7	50.8	69.3	223.5	
Zone 2	41.6	59.9	60.0	60.9	222.4	
Zone 3	47.9	53.0	33.9	65.1	199.9	
Zone 14	48.6	48.9	49.7	52.1	199.3	Priority 3
Zone 5	51.2	43.7	79.2	25.0	199.1	
Zone 11	58.6	48.0	80.3	9.4	196.3	
Zone 8	65.4	46.6	47.9	27.6	187.5	
Zone 15	50.1	54.3	45.7	33.8	183.9	Priority 4
Zone 12	54.2	50.1	62.6	9.4	176.3	
Zone 7	59.1	42.4	46.8	10.4	158.7	

8.3 Screening of Bridges

Screening Criteria

The bridge conforming to any of the following conditions is disqualified for project bridge:

1)	Coverage by Other Project Construction of the bridge has been committed in a certain other project.
2)	No Urgent Necessity of Reconstruction The bridge is presently usable for vehicular traffic in fair condition and therefore its reconstruction is not urgently needed.
3)	Inappropriateness of Applying Portable Steel Bridge Type The construction of the bridge with portable steel bridge type is impracticable. The following bridges fall in this case: 3-1) The bridge with a length of more than 300 meters (the girder erection is difficult). 3-2) The bridge with a length of more than 150 meters on the river with a dry season water depth of more than 1.2 meters (the girder erection is difficult even applying the draw erection method). 3-3) The bridge with a length of less than 10 meters (the other type like box culvert is more suitable for this bridge).
4)	Improper Condition of Connecting Road There is no connecting road passable for vehicles.

Screening

As a result of screening, 54 bridges are disqualified.

Criteria	Applicable bridges District and number of bridges in ()
1) Coverage by Other Project	Narshindgi(1), Chandpur(2), Noakhali(1), Sirajganj(2), Bogra(1) Total 7 bridges
2) No Urgent Necessity of Reconstruction	none
3) Inappropriateness of Applying Portable Steel Bridge Type 3-1) bridge length > 300m	Noakhali(1), Rangamati(1), Khulna(1), Satkhira(1), Narail(3), Bogra(1) Total 8 bridges
3-2) bridge length > 150m and dry season water depth >1.2m	Munshiganj(1), Manikganj(2), Tangail(1), Jamalpur(3), Netrakona(1), Shariatpur(1), Madaripur(1), Chittagong(1), Comilla(1), Chandpur(1), Cox's Bazar(1), Rangamati(1), Sunamganj(2), Khulna(5), Barisal(1), Naogaon(3), Nawabganj(2), Sirajganj(4), Pabna(2), Bogra(3), Thakurgaon(1), Lalmonirhat(1) Total 39 bridges
3-3) bridge length < 10m	none
4) Improper Condition of Connecting Road	none

8.4 Prioritization of Bridges

Prioritization Criteria

The evaluation of priority of the project bridges is made from two aspects: engineering factors (necessity/urgency of bridge construction) and socioeconomic factors (effect of bridge construction). The priority of the project bridges is determined in the following steps:

- 1) Engineering factors and socioeconomic factors are evaluated by calculating the scores in accordance with the criteria shown below.
- 2) Based on the engineering and socioeconomic scores, the project bridges are divided into three priority groups: A, B and C, in accordance with the criteria shown below.
- 3) The priorities of the bridges on the same route are reviewed and adjusted as necessary. If the priority of a bridge is lower than that of another bridge on the same route leading to an arterial road and farther from the arterial road, the priorities of the two bridges are re-evaluated applying their average score.

Criteria for calculating Engineering Score

Factor	Condition	Score
a. Road Class	Feeder Road-B	20
	Rural Road-1	13
	Rural Road-2	7
	Rural Road-3	0
b. Existing Bridge	No existing bridge passable for vehicles	40
	Existing bridge passable for vehicles	0
c. Connecting Road	Paved in good/fair condition	30
	Paved in poor condition	20
	Earthen	0
d. Alternative Route	No alternative route	10
	Alternative route with a length of more than 2 km	5
	Alternative route with a length of 2 km or less	0
Full Score		100

Criteria for calculating Socioeconomic Score

Factor	Score	Maximum Score
a. Beneficiaries	Score = $0.001 * P * \text{Multiplier}$ Where, P: number of beneficiaries (ceiling: 30,000) Multiplier: refer to factor 'e' below	30
b. Vehicular Traffic Volume	Score = $0.1 * VV * \text{Multiplier}$ Where, VV: truck+bus+car+rickshaw/2+bullock cart/2 (Ceiling: 200) Multiplier: refer to factor 'e' below	20
c. Pedestrian Volume	Score = $0.01 * PV * \text{Multiplier}$ Where, PV: pedestrian volume (ceiling: 2,000) Multiplier: refer to factor 'e' below	20
d. Public Facilities	Score = $1.0 * PF * \text{Multiplier}$ Where, PF: total number of public facilities (ceiling: 30) Multiplier: refer to factor 'e' below	30
e. Bridge Length	Multiplier = 1.0 for the bridge with a length of 10m-30m 0.9 for the bridge with a length of 35-75m 0.7 for the bridge with a length of 80-125m 0.5 for the bridge with a length of 130m or more Note: multiplier is commonly applied to factors 'a' to 'd' above.	
Full Score		100

Criteria for Determining Bridge Priority

Priority Group	Criteria
A	Engineering score 63 or more, and Socioeconomic score 53 or more
B	Not meeting the above condition, but Engineering score 50 or more, and Socioeconomic score 40 or more
C	Others

Result of Prioritization

Number of bridges, total length, total cost of each priority group are summarized as followed:

Number of Bridges by Priority Group

		Bridge Priority				Total
		A	B	C		
Zone Priority	1	(1A) 147	(1B) 123	(1C) 46	316	
	2	(2A) 79	(2B) 91	(2C) 85	255	
	3	(3A) 69	(3B) 67	(3C) 111	247	
	4	(4A) 85	(4B) 80	(4C) 115	280	
	Total	380	361	357	1,098	

Total Length of Bridges by Priority Group (m)

		Bridge Priority				Total
		A	B	C		
Zone Priority	1	(1A) 7,585	(1B) 6,805	(1C) 3,060	17,450	
	2	(2A) 4,280	(2B) 5,080	(2C) 5,455	14,815	
	3	(3A) 3,755	(3B) 4,240	(3C) 4,140	12,135	
	4	(4A) 3,845	(4B) 4,655	(4C) 5,815	14,315	
	Total	19,465	20,780	18,470	58,715	

Total Cost of Bridges by Priority Group (crore taka)

		Bridge Priority				Total
		A	B	C		
Zone Priority	1	(1A) 302.3	(1B) 269.5	(1C) 120.1	691.9	
	2	(2A) 165.0	(2B) 195.9	(2C) 208.4	569.3	
	3	(3A) 145.0	(3B) 162.8	(3C) 165.8	473.6	
	4	(4A) 150.6	(4B) 176.6	(4C) 223.9	551.1	
	Total	762.9	804.8	718.2	2,285.9	

8.5 Cost Estimate

Span Arrangement

Principles of span arrangement are as follows:

- 1) For the convenience of standardization of superstructure, applicable spans shall be 10m, 15m, 20m, 25m and 30m. All bridges are composed of these spans.
- 2) 2-span and 4-span shall not be applied in order not to locate a pier at the center of the river. In case of 6 or more-span, however, even number of spans is allowed.
- 3) Application of 10m-span and 30m-span is limited to special cases because the former is uneconomical and the latter is difficult to be erected due to heavier weight of a member.
- 4) Number of spans shall be minimum for the economical reason.

Standard Structure

Standard types of abutment and superstructure are shown on following pages.

Unit Cost

Item		Unit	Cost (Tk.)
Abutment	4.5m or less in height	2 numbers	2,630,420
Including 20m approach road and riverbank protection	4.5 to 6.5m in height	2 numbers	2,950,075
	6.5 to 9.0m in height	2 numbers	3,405,470
Additional approach road		meter	4,644
Pier	6m or less in height	1 number	929,075
	6 to 10m in height	1 number	1,388,460
	10 to 15m in height	1 number	1,903,085
Superstructure including custom duty		meter	293,000
Superstructure erection		meter	6,300

8.6 Implementation Schedule

The implementation schedule is prepared taking into consideration the following:

- Bridges in each priority group form a package. Accordingly, the project is composed of 12 packages.
- Since the possible investment amount for the project is estimated to be 170 to 200 crore taka per year, each package is scheduled such that the annual fund requirement is within the possible investment amount.

Priority Group	No. of Bridges	Total Length (m)	Total Cost (crore)	Implementation Schedule												
				2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
1A	147	7,535	302.3	170.0	132.3											
1B	123	6,805	269.5				120.0	149.5								
1C	46	3,060	120.1						30.1	40.0						
2A	79	4,230	165.0		55.0	110.0										
2B	91	5,030	195.9					93.0	97.9							
2C	85	5,455	208.4								52.1	104.2	52.1			
3A	69	3,755	145.0			72.5	72.5									
3B	67	4,240	162.8							103.5	54.3					
3C	111	4,140	165.8									41.5	32.8	41.5		
4A	35	3,245	130.6					50.2	100.4							
4B	80	4,655	176.6							44.2	38.2	44.2				
4C	115	5,315	223.9										56.0	111.9	56.0	
Total	1,098	58,715	2,285.9													
Annual Fund Requirement				170.0	187.3	182.5	192.5	199.7	198.4	178.0	192.7	194.6	189.9	190.9	153.4	56.0

9 BRIDGES IN PRIORITY ZONES

9.1 Bridge Site Survey

The study bridges in priority-1 zones (zone-1, 4, 6 and 13) numbering 339 in 18 districts are selected for site survey to get the detailed data.

9.2 Major Indicators

Based on the bridge site survey, socioeconomic and environmental indicators are obtained by priority group as follows:

Item		Priority 1A	Priority 1B	Priority 1C	Total
Number of bridges		147	123	46	316
Existing bridge	No bridge	110	92	29	231
	Timber/bamboo bridge	31	19	9	59
	Permanent bridge in poor condition	6	12	8	26
Population in influence area ('000')		3869	2726	583	7178
Industry	Main industries Major agricultural products	Agriculture Rice, Jute, Wheat, Veg.	Agriculture Rice, Jute, Wheat, Veg.	Agriculture Rice, Jute, Wheat, Veg.	Agriculture Rice, Jute, Wheat, Veg.
Expected total Traffic volume	Car	2475	1608	481	4564
	Pick up/truck	2752	1801	479	5032
	Bus	2210	1632	444	4286
	Motorcycle	10083	6374	1338	17795
	Rickshaw/van	30355	23739	5737	59831
	Autorickshaw	5607	5309	1121	12037
	Bullock cart	1218	580	252	2050
	Pedestrian	390100	287685	62076	739861
Number of public facilities in influence area	School	1608	1001	269	2878
	Clinic	432	270	76	778
	Bazar	603	440	104	1147
	Mosque	2204	1632	355	4191
	Government Office	595	407	70	1072
	Other public facilities	801	702	178	1681
	Total	6243	4452	1052	11747
Environmental issue	Land to be acquired (m ²)	10880	14212	2780	27872
	Number of houses to be relocated	14	19	2	35

9.3 Assessment of Project Effects

Mechanism of Generating Effects of Rural Road Development

Mechanism of Generating the effects of rural road development especially by bridge construction is shown on page 22.

Beneficiaries

Direct beneficiaries of the project are the population residing in 18 districts in the priority zones, amounting to 42.7 million. Influence area populations of priority 1A, 1B and 1C bridges are 3.9, 2.7 and 0.6 million respectively totaling 7.2 million, who are more direct beneficiaries.

Direct Effects of the Project

- Provision of safe and stable transport means

Due to absence of uninterrupted and stable transport means, people face tremendous trouble in marketing of agricultural products, accessing to public facilities, etc. 231 bridge sites (73%) have no existing bridges, 59 sites (19%) have timber or bamboo bridges good for pedestrians only, and remaining 26 sites (8%) have permanent bridges in poor condition. The project will provide the safe and stable transport means by constructing bridges.

- Increase of transport capacity

Transport capacity of the existing road is very limited due to absence of bridge. In many cases, traffic is completely interrupted during rainy season. Transport capacity will be drastically increased by bridge construction. Average daily traffic demands of car, pickup/truck, bus, rickshaw, autorickshaw and pedestrian per bridge are 14, 16, 14, 189, 38 and 2,341 respectively.

- Saving in transport cost

In the absence of bridge, people usually carry their goods by boat, which requires high cost and time. By bridge construction, transport cost will be saved.

- Saving in bridge maintenance cost

Where locally made bamboo/timber bridges are used for crossing the rivers, maintenance costs and occasional reconstruction costs are required. Where permanent bridges exist, the bridges are weak and often require the repair costs. All these costs will be saved by the project.

- Improvement of inhabitants' daily life

The road plays an important role in daily life of inhabitants for attending school, communing, shopping, visiting clinic and mosque, etc. Total number of public facilities in the influence areas of the project bridges is 11,747 (6,243 in priority 1A bridges, 4,452 in 1B bridges and 1,052 in 1C bridges). The project will improve the accessibility to those public facilities and thus contribute to the improvement of inhabitants' daily life.

Indirect Effects of the Project

- Encouragement of road network development

In the absence of bridges, the existing roads are not fully utilized. Construction of the bridges will make the roads usable effectively. Furthermore it will encourage the improvement of the connecting/related roads and thus the project will make an impact on overall road network development of the area.

- Acceleration of agricultural production

Provision of marketing means of agricultural products and lower cost of agricultural inputs will stimulate the farmer's will to produce marketable products and consequently agricultural production will be accelerated. The priority zones have 35% of total population of the country including the capital Dhaka. It demonstrates high demand of agricultural products.

- Promotion of industries

Transport industries will be promoted by the provision of stable means of transport and agro-industries such as food processing will be promoted by the increase of agricultural production. Other industries may also be promoted as a result of activation of local economy by the project.

- Increase of employment opportunities

As a result of industrial development and activation of local economy by the project, employment opportunities will be generated/increased.

- Stabilization of prices

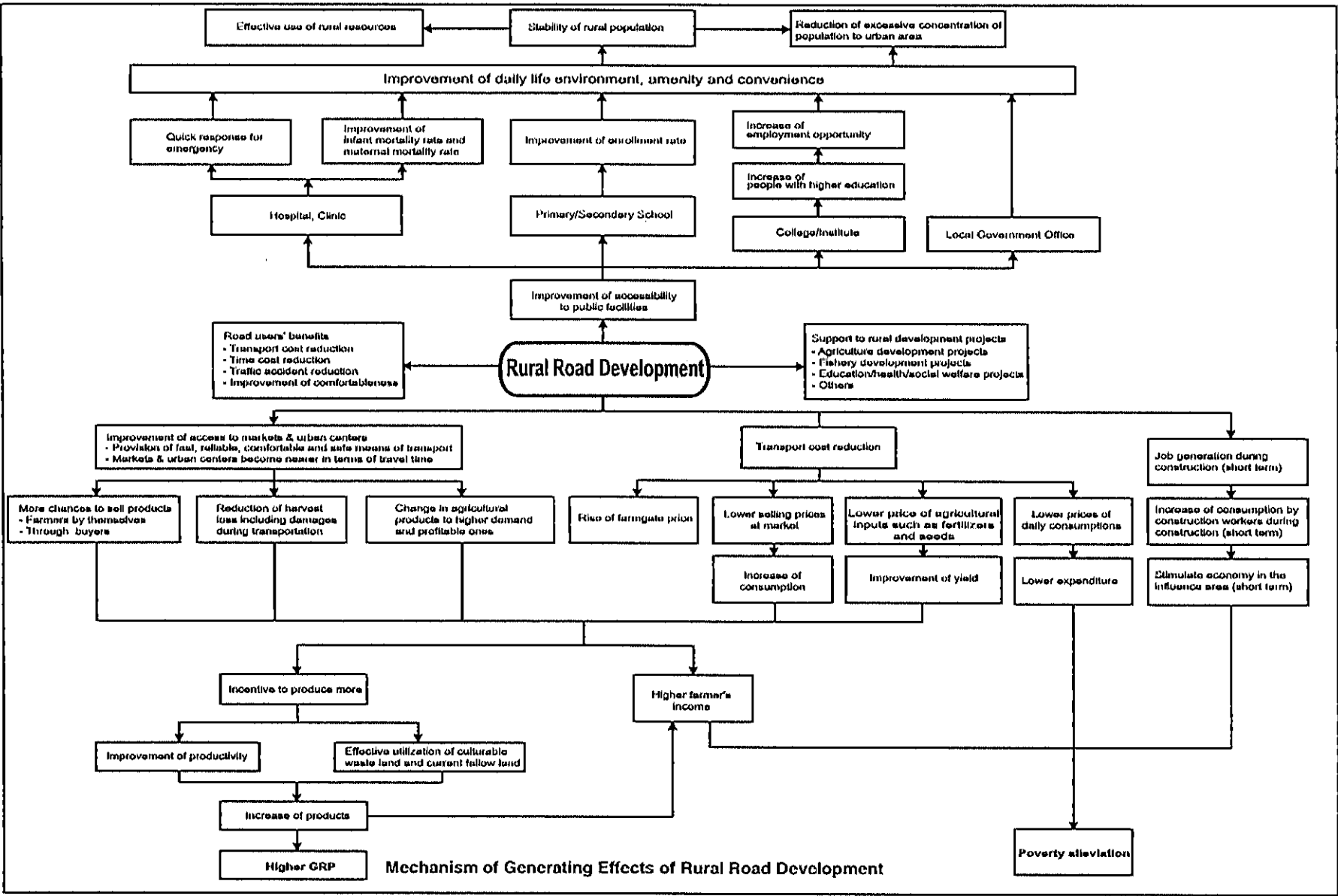
Commodity prices depend on demand and supply. If the steady supply is secured, commodity prices will be stabilized and lowered. The project will provide the stable means of transport and thereby help the steady supply of commodities.

- Alleviation of poverty

The project will contribute to the alleviation of poverty through increase of farmer's income, acceleration of agricultural production, promotion of industries, increase of employment opportunities, stabilization of prices, etc.

- Promotion of the effects of other development projects

Effects of rural development projects will not fully attained without effective transport means. Improvement of road transport by construction of bridges will support/promote the development projects. There are many development projects in the priority zones and therefore the impact of the bridge construction project on those development projects will be big.



Mechanism of Generating Effects of Rural Road Development