

THE PEOPLE'S REPUBLIC OF BANGLADESH
FLOOD PLAN COORDINATION ORGANIZATION

MASTER PLAN
FOR
GREATER DHAKA PROTECTION PROJECT
(STUDY IN DHAKA METROPOLITAN AREA)
OF
BANGLADESH FLOOD ACTION PLAN NO.8A

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ABBREVIATIONS

ADB	Asian Development Bank
AIT	Asian Institute of Technology
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorological Department
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CAAB	Civil Aviation Authority of Bangladesh
DIT	Dhaka Improvement Trust (now RAJUK)
DMAIUDP	Dhaka Metropolitan Area Integrated Urban Development Plan
DMC	Dhaka Municipal Corporation
DND Triangle	Dhaka - Narayanganj - Demra Triangle
DPHE	Department of Public Health Engineering
DOE	Department of Environment
DWASA	Dhaka Water and Sewerage Authority
ERD	External Resources Division Ministry of Finance
FAP	Flood Action Plan
FPCO	Flood Plan Coordination Organization
GDPP	Greater Dhaka Protection Project
GDFCD Project	Greater Dhaka Flood Control and Drainage Project
GOB	Government of Bangladesh
JICA	Japan International Cooperation Agency
MIWDFC	Ministry of Irrigation, Water Development and Flood Control
MPO	Master Plan Organization
PDB	Power Development Board
PHD	Public Health Department
PWD	Public Works Department
RHD	Roads and Highways Department

RAJUK	Rajdhani Unnayan Katripakha (Capital Development Authority)
RRI	River Research Institute of the Ministry of Irrigation, Water Development and Flood Control
SOB	Survey of Bangladesh
SWMC	Surface Water Modelling Center
SPARRSO	Space Research and Remote Sensing
UNCHS	United Nations Center for Human Settlements
UNDP	United Nations Development Programme
WAPDA	Water and Power Development Authority
WASA	Water and Sewerage Authority
WMO	World Meteorological Organization

SUPPORTING REPORT A

GEOGRAPHY AND TOPOGRAPHY

SUPPORTING REPORT A GEOGRAPHY AND TOPOGRAPHY

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SUPPORTING REPORT A: GEOGRAPHY AND TOPOGRAPHY

1. Location and Land Form

The study area (approx. 850 km²) is situated in between lat. 23°34' N-lat. 23°59' N and long. 90°13' E-long. 90°33' E, and consists of the Greater Dhaka and part of Tongi, Savar, Keraniganj and Narayanganj (Fig. A.1).

The study area is composed of alluvial terraces and low lying areas. Dhaka city and surrounding towns are located mainly on alluvial terraces, named the Madhupur Jungale Terrace.

A rough land form map which illustrates stretches of comparatively high elevated areas and low lying areas in the study area was prepared based on the contour maps collected, accuracy of which is likely to be considerably varied (refer. Fig. A.2).

The map shows the following land form areas :

<u>Land form Area</u>	<u>Description</u>
- 1	higher than 10.0 meter (GTS)
- 2	8.0 - 10.0 meter (GTS)
- 3	6.0 - 8.0 meter (GTS)
- 4	4.0 - 6.0 meter (GTS)
- 5	2.0 - 4.0 meter (GTS)
- 6	lower than 2.0 meter (GTS)

The land form areas -1 and -2 are supposed to be safe from normal floods, but the land form area -3 seems to be marginally free from floods. Distinct low land is lying towards the north-west and east side of Dhaka city.

2. Available Topographic Map

Several kinds of topographic maps were collected from SOB, BWDB, SPARRSO and other concerned agencies through FPCO coordination. They are listed below.

<u>Scale</u>	<u>Description</u>
1. 1: 4,000	: prepared in 1986 with contour lines covering only a part of Narayanganj (Fig. A.3).
2. 1: 7,920	: prepared in 1965 - '72 with contour lines covering G. Dhaka, Keraniganj and partly Tongi and Narayanganj (Fig. A.4).
3. 1: 15,840	: prepared in 1964-'72 with contour lines covering Savar, partly Tongi and Narayanganj (Fig. A.5).
4. 1: 10,000	: prepared in 1989 partly with contour lines based on aerial photos 1983/84 covering G. Dhaka, Keraniganj, Tongi and partly Narayanganj (Fig. A.6).
5. 1: 20,000	: reduced map of the above 1 : 10,000 scale map.
6. 1: 50,000	: prepared in 1971-'89 covering the whole country with no contour lines (Fig. A.3).
7. 1: 50,000	: spot satellite image taken in February - March, 1989 covering the whole country, indexed as of Fig. A.3.

Except the spot image map, the 1/10,000 scale map is the latest available map with recent field verification. The 1/50,000 scale map (No. 6 of above) was prepared by using old air-photos, and also contour maps of scales 1/7,920 (No. 2 of above) and 1/15,840 (No. 3 of above) were prepared during the period of East Pakistan.

Accordingly, above maps are old to use for the master plan. So, the 1/50,000 scale map is required to update by the latest maps, air-photos, field verification and other available data.

3. Survey Datum

Two datums, called GTS and PWD are used for elevation survey in Bangladesh. The GTS (Great Trigonometrical Survey) is the Bangladesh standard datum of levelling. The national topographic map series is prepared based on GTS. On the other hand, PWD datum is used for hydrographic survey. The relationship of both datums is ;

$$\text{PWD} = \text{GTS} + 1.509 \text{ feet}$$

In the study area and its surroundings, there are seven (7) GTS bench marks established by SOB and eight (8) BWDB bench marks based on PWD datum. The location and elevations of these control points are shown in Fig. A.7 and Table A.1 respectively.

Out of the above control points, Ramna BM (GTS bench mark), which was used in JICA previous surveys from 1987 to 1990, was selected as the basic bench mark in this leveling survey. The elevation of Ramna BM is 24.2718 ft, a value that was confirmed by check levelling survey between Mymensingh and Comilla during 1966 - 1967.

4. Supplementary Survey

4.1 General

The supplementary survey was carried out to obtain the necessary data for hydrological and hydraulic analysis, and formulation of flood mitigation and stormwater drainage plan.

The supplementary survey consists of the followings ;

- 1) For updating the existing topographic maps (1:50,000, 1:20,000)
 - Spot height survey of the whole study area
 - Spot height survey for preparation of contour lines of low lands
- 2) For preparation of longitudinal and cross sections of rivers and drainage channels
 - Longitudinal and cross sectional survey
- 3) For existing facilities
 - Levelling and structural dimension survey

4.2 Updating of Existing Topographic Map

4.2.1 Spot height survey

1) Spot height of whole study area

In order to obtain a general feature of ground elevation in the whole study area, spot levelling was conducted along the existing roads shown in Fig. A.9. This survey was carried out at intervals of 200 m along the road. At each road location spot height determined of every 250 m pitch for a symmetric cross section of 0.5 km to either side of the road (a total of 1 km).

The total number of spot heights was approx. 5,700 points. The elevation of key points were indicated on the updated 1: 50,000 scale map.

2) Spot height of low land area

Grid spot height levelling was carried out at intervals of 100 m by 200 m. These data was used to draw the 50 cm contour lines of low land areas shown in Fig. A.10. The total number of grid heights were approx. 800 points.

4.2.2 1/50,000 scale map

The existing 1: 50,000 national map was updated based on the following available data. The updated map is used as the base map of this master plan study.

- 1) Satellite coloured spot image maps taken in February - March, 1989
- 2) 1/10,000 scale SOB maps (DHAKA CITY AND SURROUNDINGS) based on aerial photos 1983/84.
- 3) 1/50,000 scale national series of coloured infra-red air-photos taken in 1983/84.
- 4) 1/50,000 scale skeleton line map (DHAKA METROPOLITAN AREA) based on 1983/84 photos, SPARRSO.

For updating the 1/50,000 map, the spot image was used for the correction of the shape of rivers, major khals and also marsh area, because it is the latest available image. The areas covered by 1/10,000 scale map, was updated using these maps. The colour infra-red air-photos were referred to correct the planimetric features.

The SPARRSO skeleton map was used to refer the names of some facilities and minor roads. These items were verified on the field during December, 1990 to January, 1991.

About 800 key spot heights were added to this 1/50,000 scale map according to the results of spot height survey.

4.2.3 1/20,000 scale map

The 1/20,000 scale map covering the Greater Dhaka and Narayanganj area of about 380 km² was prepared for the subsequent feasibility study.

Following maps were used for this preparation:

- 1) 1/20,000 scale SOB maps.
- 2) 1/10,000 scale Dhaka city map prepared by JICA study team on Storm Water Drainage System Improvement Project, October 1987.
- 3) 1/15,840 scale Water Development Map

New maps were compiled from the above three kind of existing maps were used. The low land areas were inserted the contour lines at the intervals of 50 cm according to the results of grid spot height survey and also, corrected by field verification in February, 1991.

The areas of contour drawing is about 170 km² as shown in Fig. A.10.

All existing maps used for this map preparation were paper printed, as such the conditions of sheet connection between successive maps was not so good at some portions.

4.3 Longitudinal and Cross Sectional Survey of River and Drainage Channels

Longitudinal & cross-sectional surveys of the five (5) rivers and 55 drainage channels in the study area were carried out during the period February to March, 1991. The surveyed longitudinal length and number of cross-section are summarized below :

River	Length (Km)	Nos. of Section
(1) Balu River	27.6	7
(2) Tongi Khal	14.4	3
(3) Turag River	30.0	4
(4) Karanatali River	11.2	4
(5) Haidarabad Khal	3.7	3
Total	86.9	21

Drainage Area	Nos. of Khal	Length (Km)	Nos. of Section
(1) Dhaka North West	8	26.1	35
(2) Dhaka East	17	54.8	72
(3) Narayanganj & DND	21	49.3	77
(4) Keraniganj	9	24.8	32
Total	55	155.0	216

Location of the above longitudinal and cross-sectional surveys are shown in Fig. A.11 & Fig. A.12. These drawings based on the PWD Datum were compiled as a survey data book.

4.4 Other Surveys

For the existing flood control facilities, following surveys were conducted.

- 1) Spot height survey of the existing flood-wall around DND project area in Narayanganj.
- 2) Structural demension survey of five (5) sluice gate at west bank of the Great Dhaka.

TABLE A.1 List of Existing Control Point

1. Geodetic Survey Mark (S.O.B)

Name of Geodetic Survey Point	Latitude	Longitude
Nayarhat B.T.S	23° 54' 33.997"	90° 13' 54.874"
Tongi B.T.S	23° 53' 45.43"	90° 24' 36.77"
Savar B.T.S.	23° 51' 36.48"	90° 16' 01.62"
Gulshan B.T.S	23° 47' 49.54"	90° 25' 06.49"
MET. Office	23° 46' 08.018"	90° 23, 01.207"

2. G.T.S. BM (S.O.B)

Name of B.M. (S.O.B)	Value in GTS
A/21	27.447 ft.
S.O.B	27.3810
B - 79	22.970
G - 8	20.370
Ramna B.M.	24.2718
G.B. M - 1	20.5154
G.B. M - 2	22.7894

3. BWDB BM (PWD)

Name of Gauge Station	B.M. Value in PWD	Latitude	Longitude
7.5 Demra	6.817 m	23° 44' N	90° 30' E
14.5 Nayarhat	9.316	23° 54' N	90° 14' E
42 Millbarak	6.776	23° 14.9' N	90° 25.3' E
69 Savar	8.358	24° 14.9' N	90° 11' E
299 Tongi	10.644	23° 52.8' N	90° 24.2' E
7 Pubail	7.529	23° 56.5' N	90° 29.8' E
302 Mirpur	10.451	23° 47.3' N	90° 20.3' E
71 Kalagachia	5.450	23° 34.7' N	90° 32.7' E

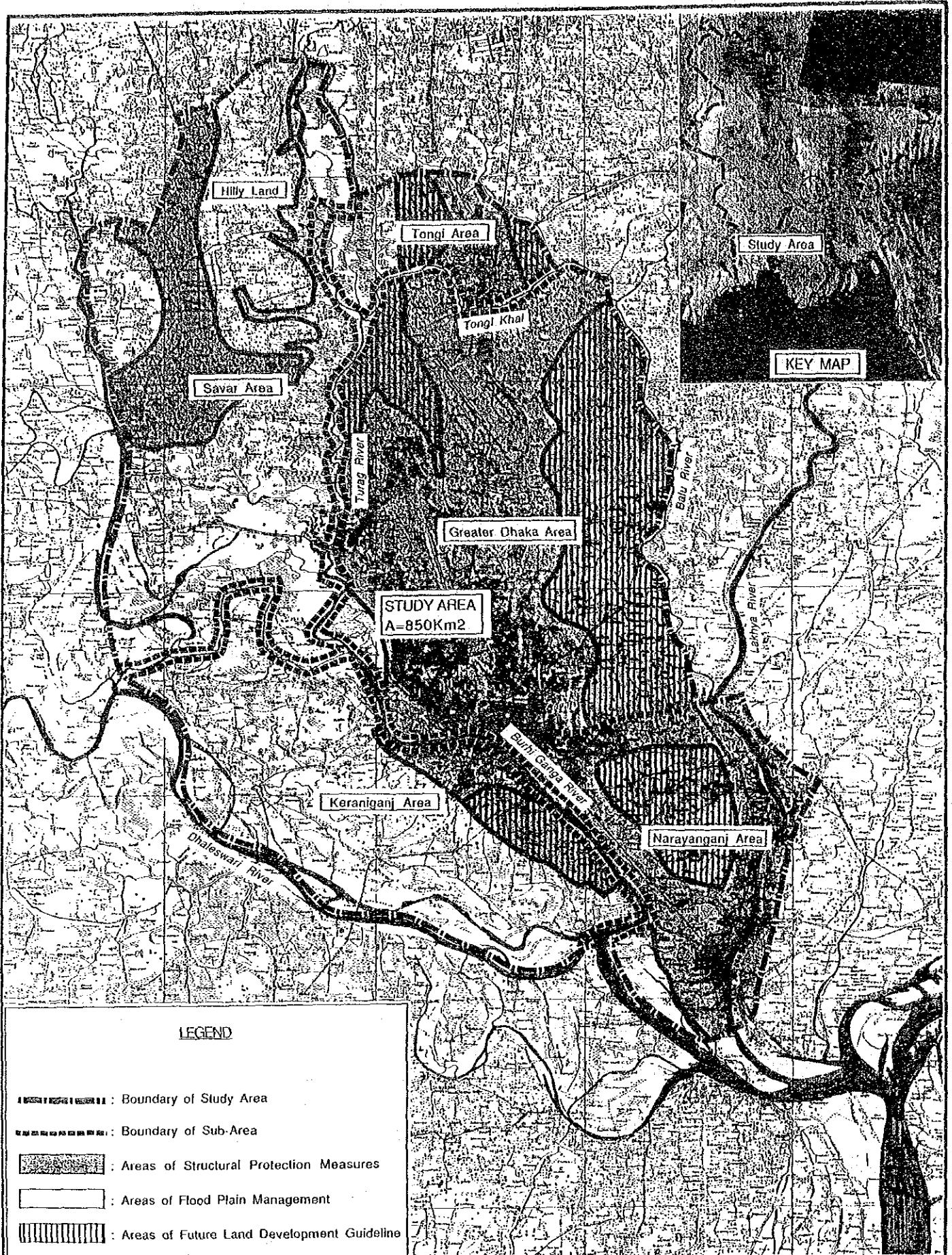


FIG. A.1

LOCATION MAP OF THE STUDY AREA

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

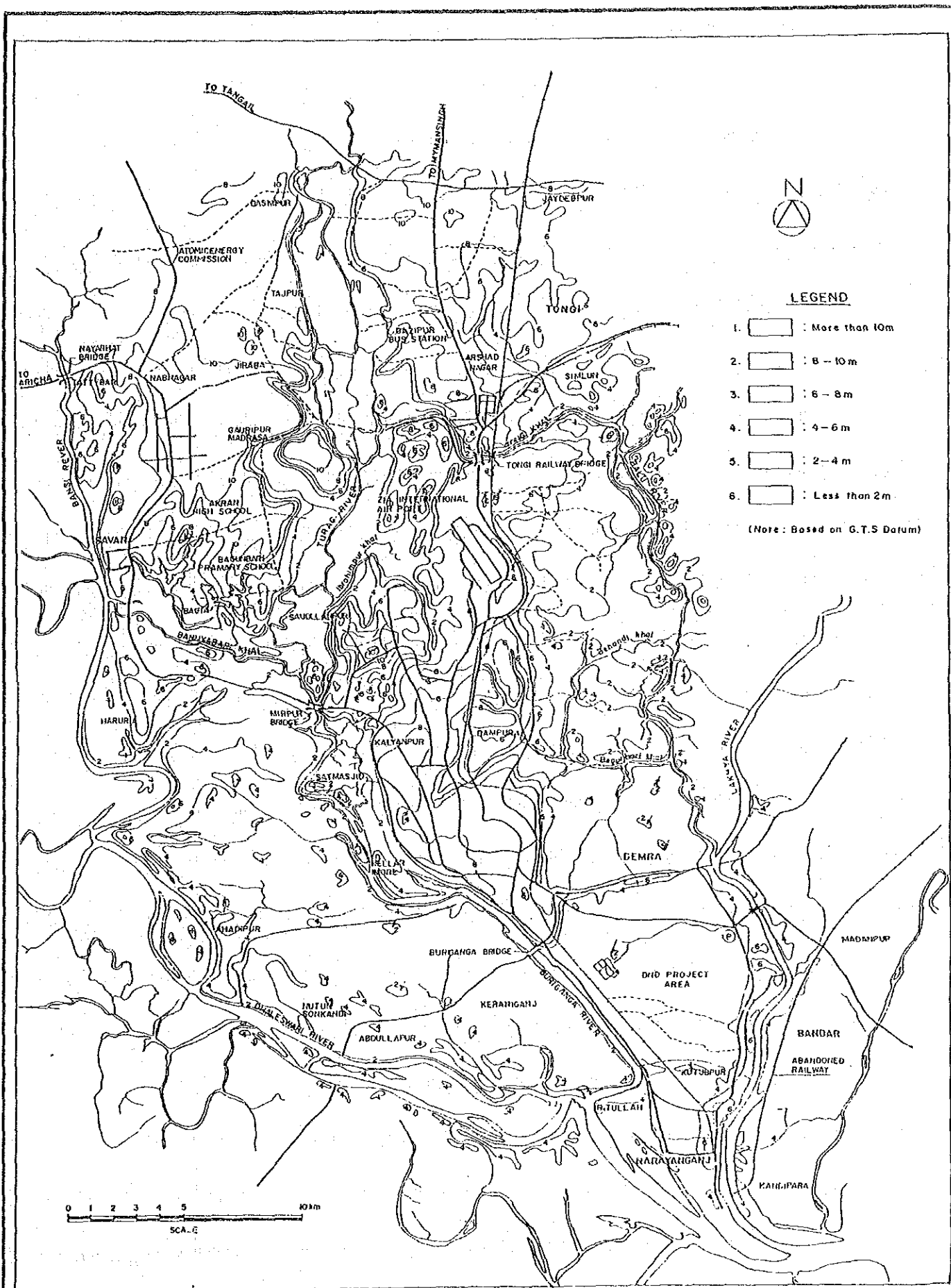
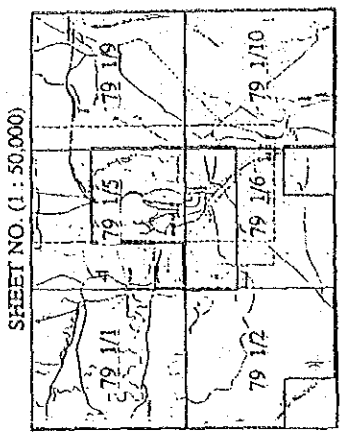
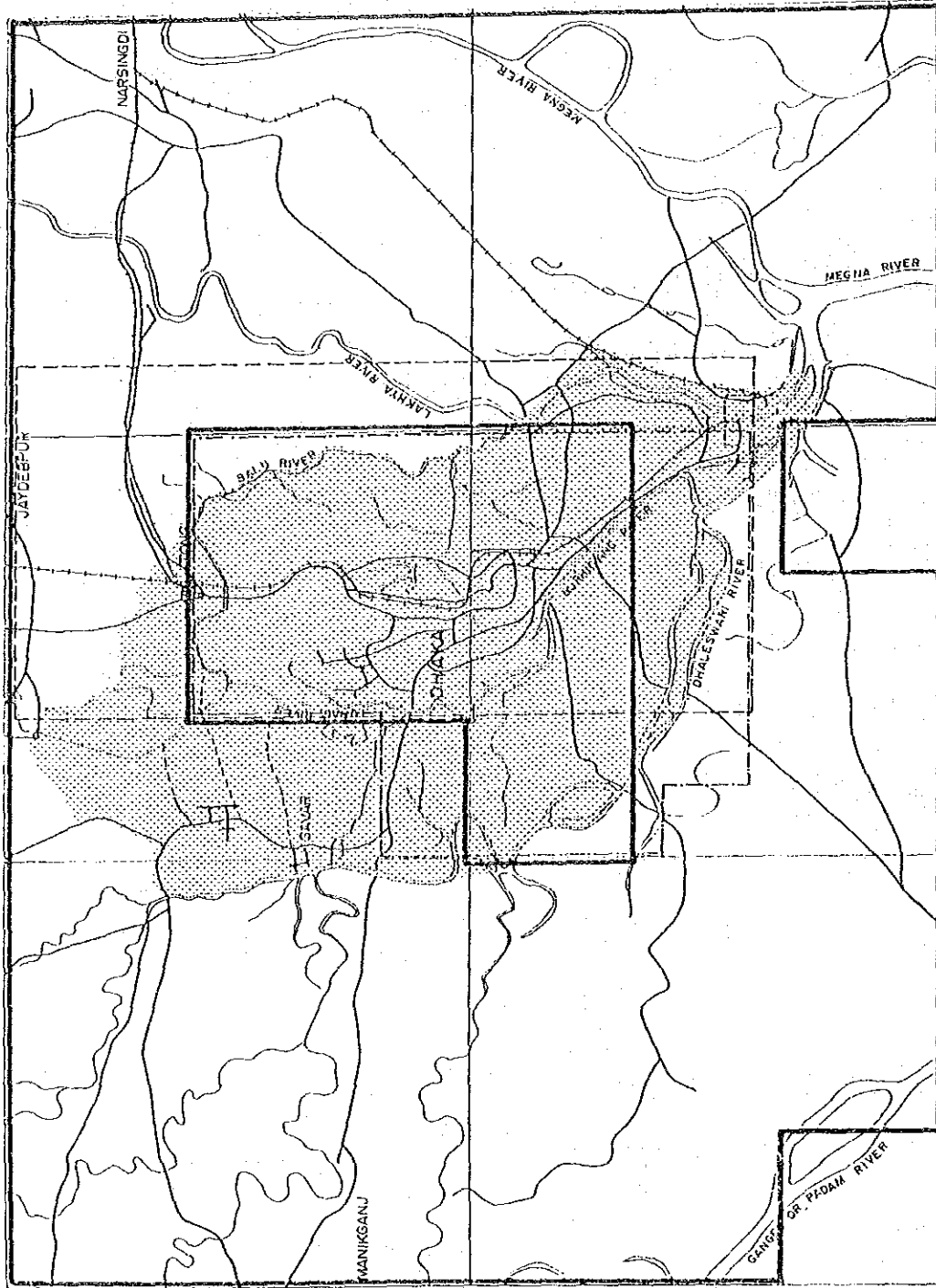


FIG. A.2

LAND FORM OF THE STUDY AREA

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



LEGEND

SCALE (SURVEY YEAR)





-  1 : 15,840 (1964 - 1972)
-  1 : 7,920 (1965 - 1972)
-  1 : 10,000 (1989)
-  1 : 4,000 (1986)



FIG. A.3 EXISTING MAP INDEX

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



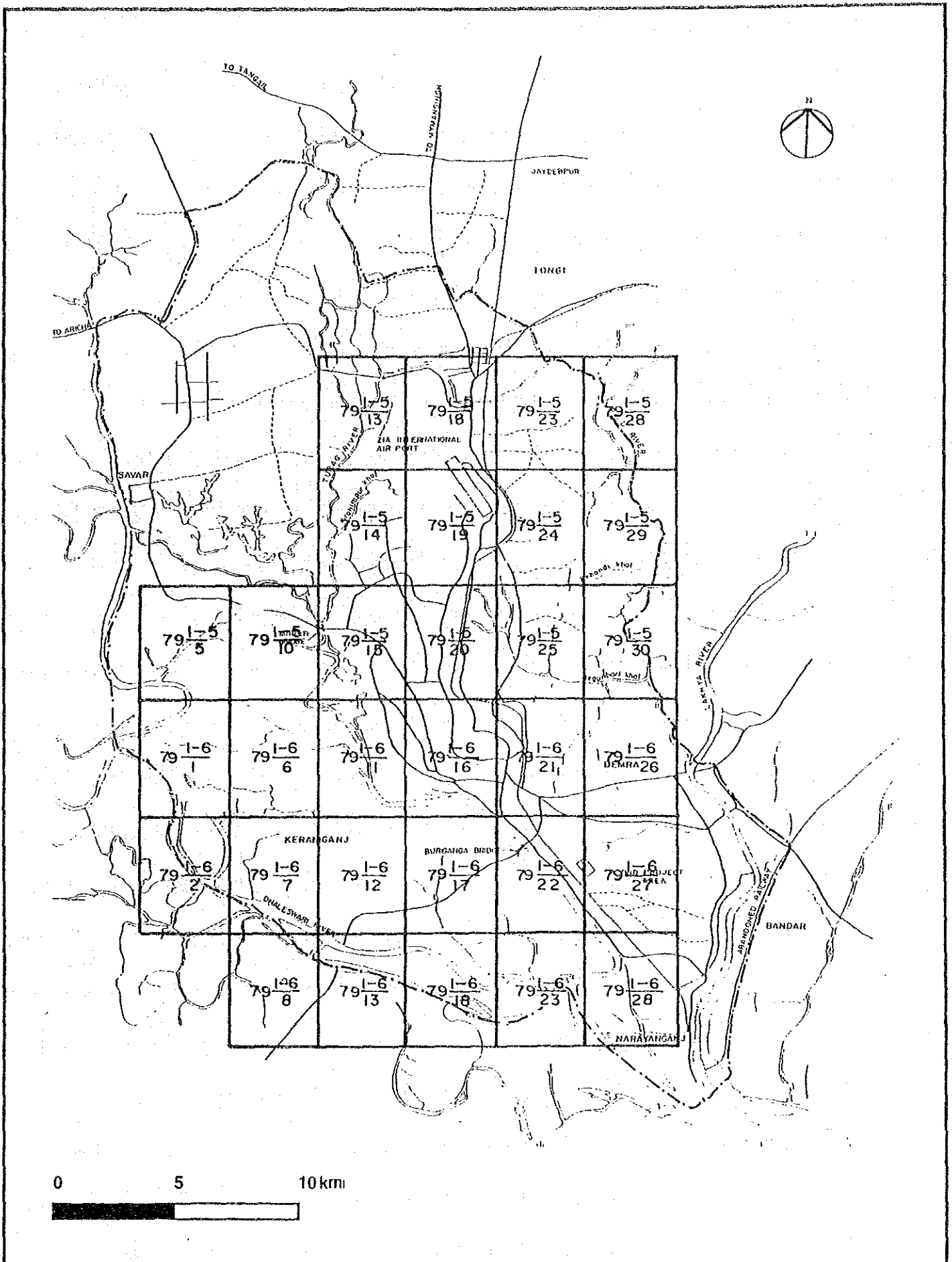


FIG. A.4

1 / 7,920 SCALE CONTOUR MAP SHEET INDEX

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

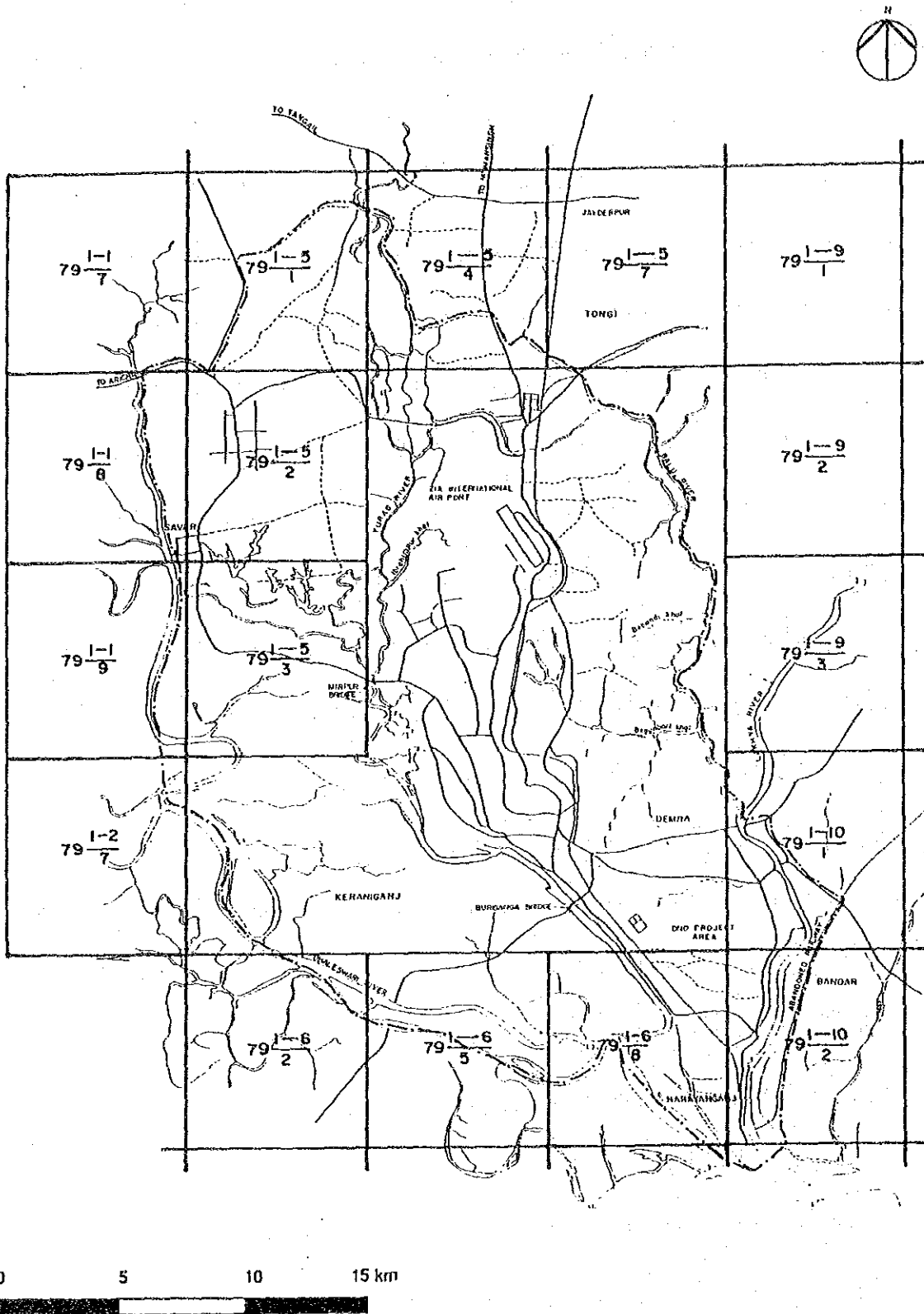


FIG. A.5

1 / 15,840 SCALE CONTOUR MAP SHEET INDEX

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

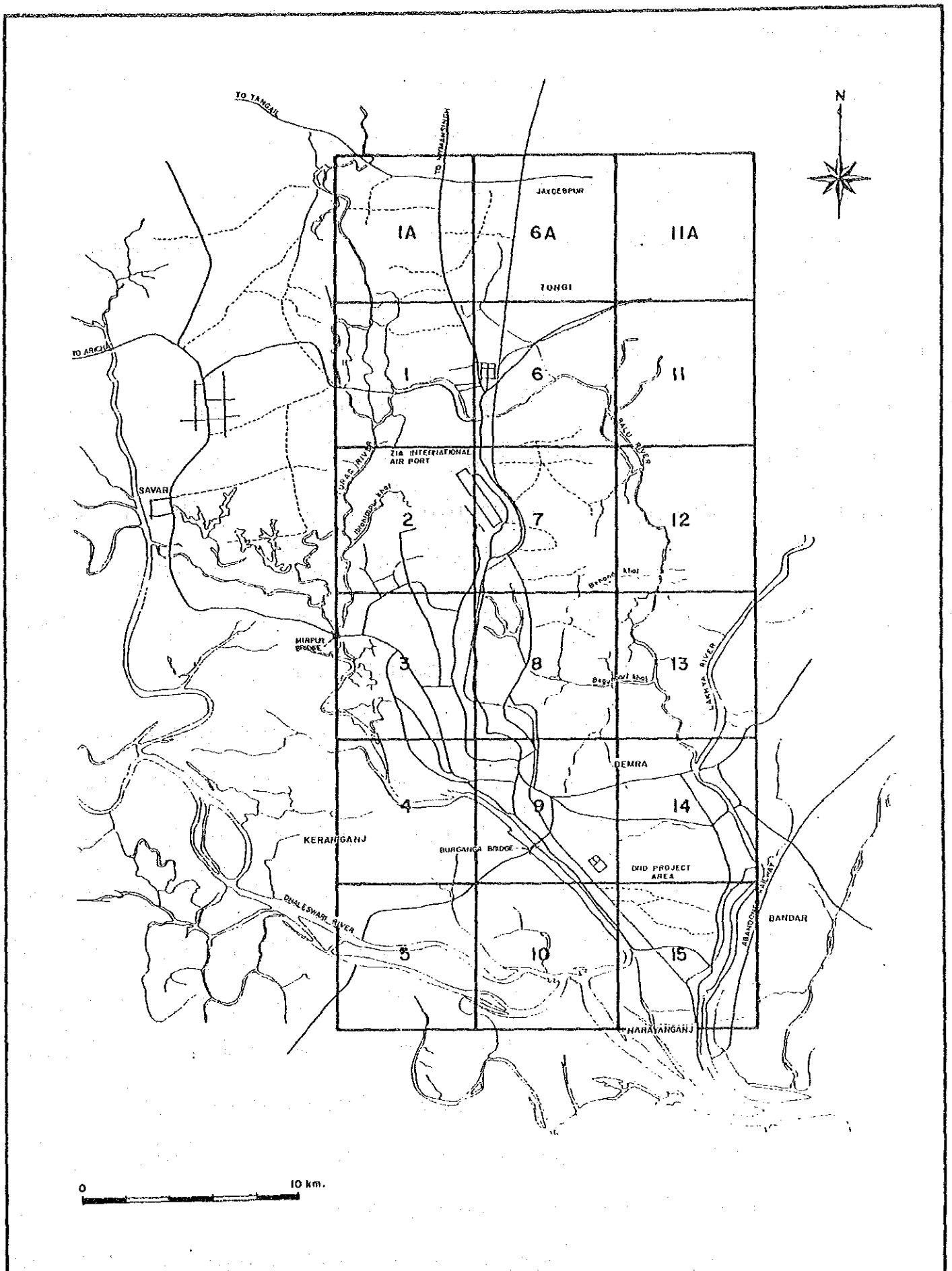
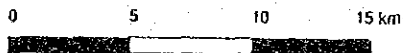
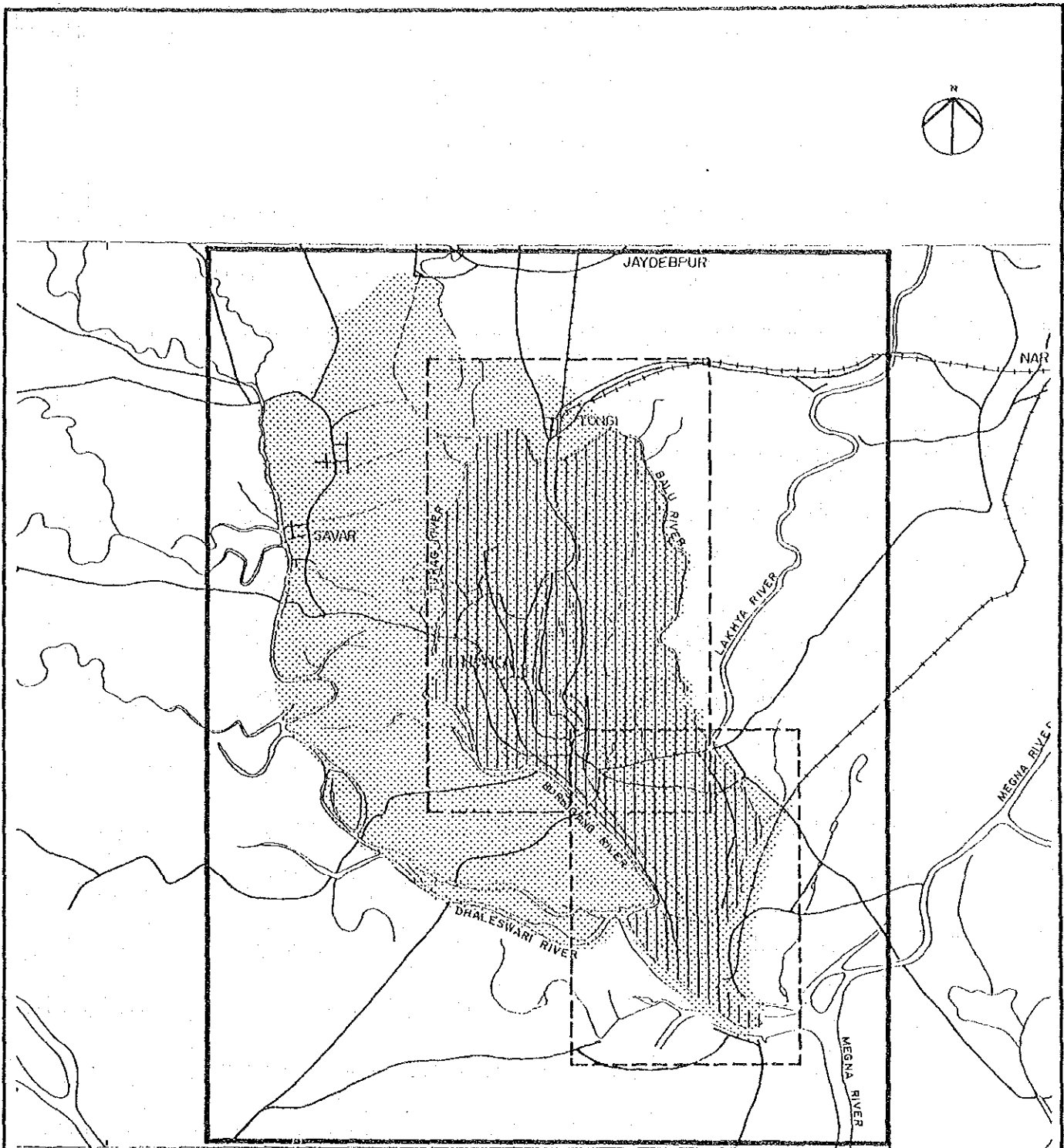


FIG. A.6

1 / 10,000 SCALE MAP SHEET INDEX

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



LEGEND

- 1/50,000 Scale Map Sheet
- 1/20,000 Scale Map Sheet
- Corrected area (850 Km²)
- Corrected area (290 Km²)

FIG. A.8 **UPDATED SHEET INDEX**

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



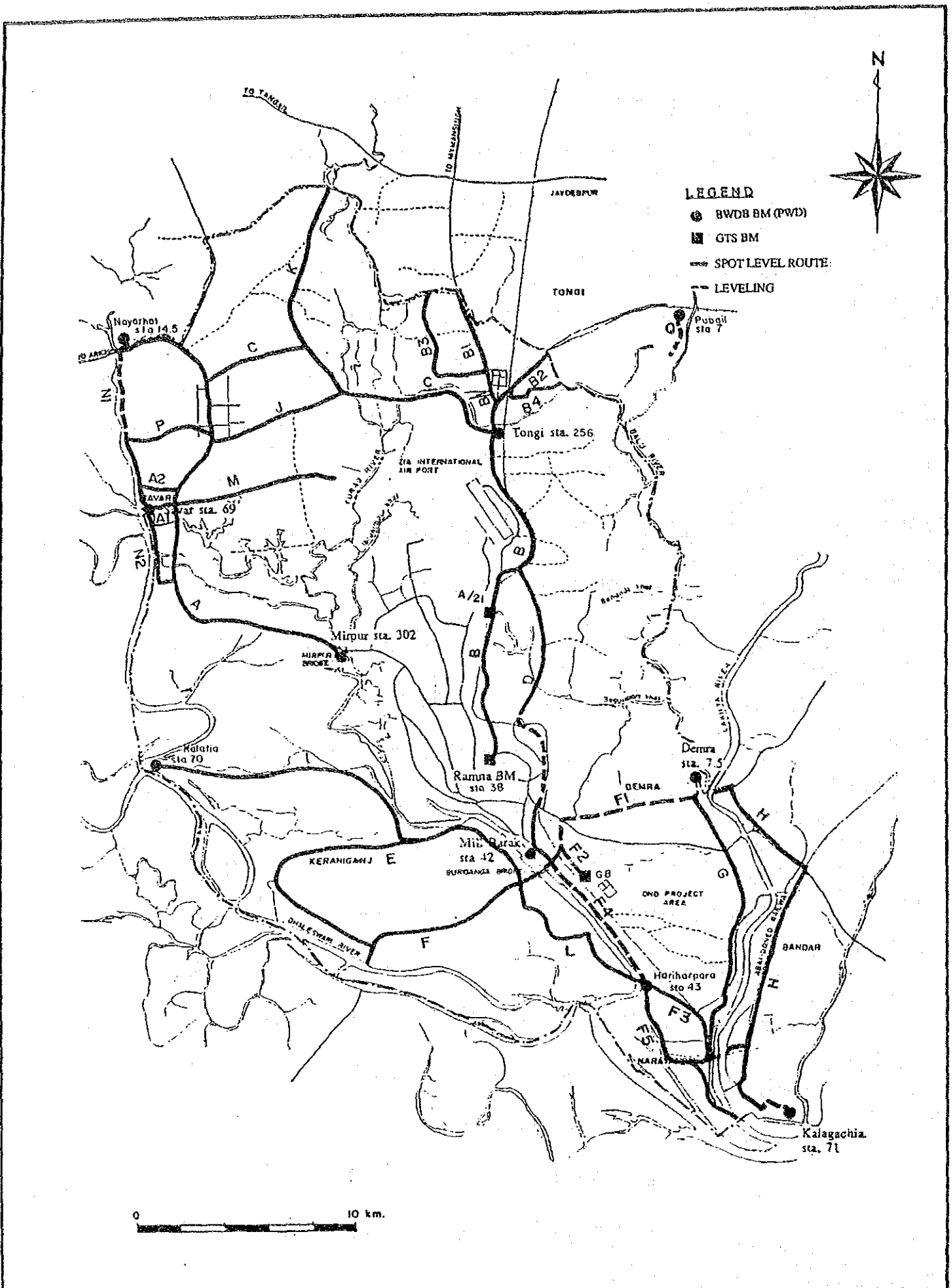


FIG. A.9

ROUTE OF SPOT LEVELING SURVEY

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



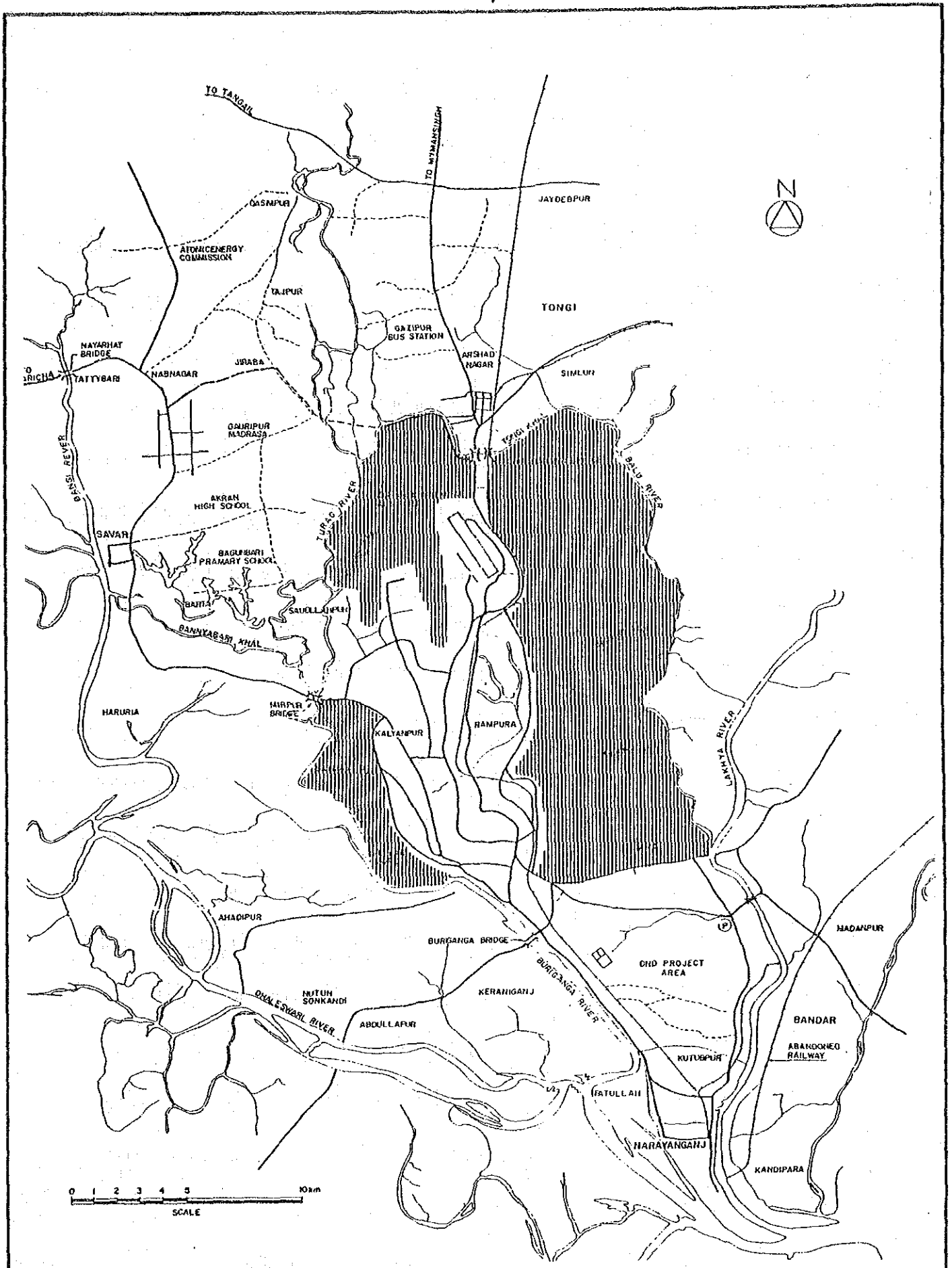


FIG. A.10

AREA OF GRID SPOT LEVELLING SURVEY

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

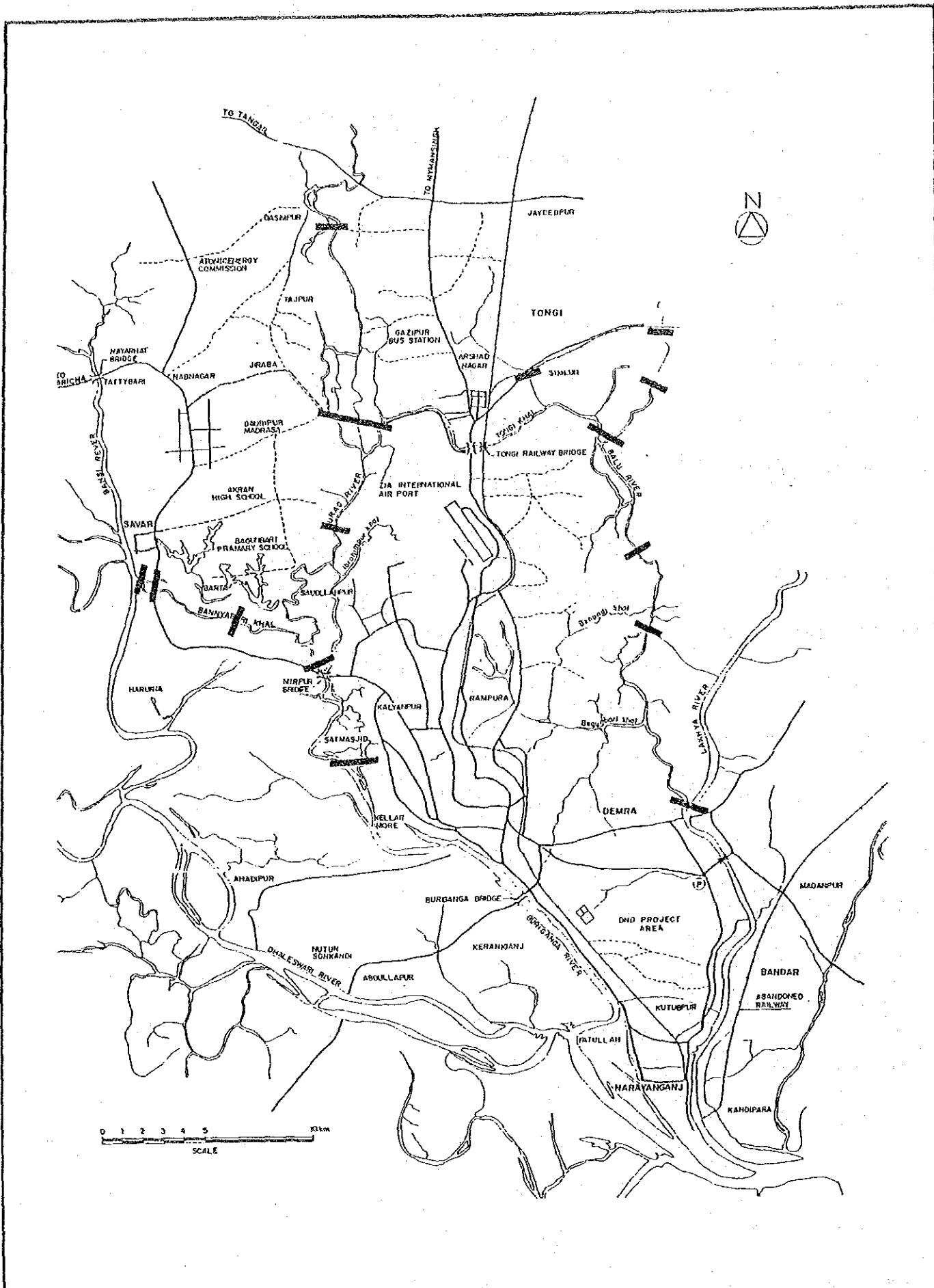


FIG. A.11

LOCATION OF LONGITUDINAL AND CROSS-SECTIONAL SURVEY OF RIVER

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

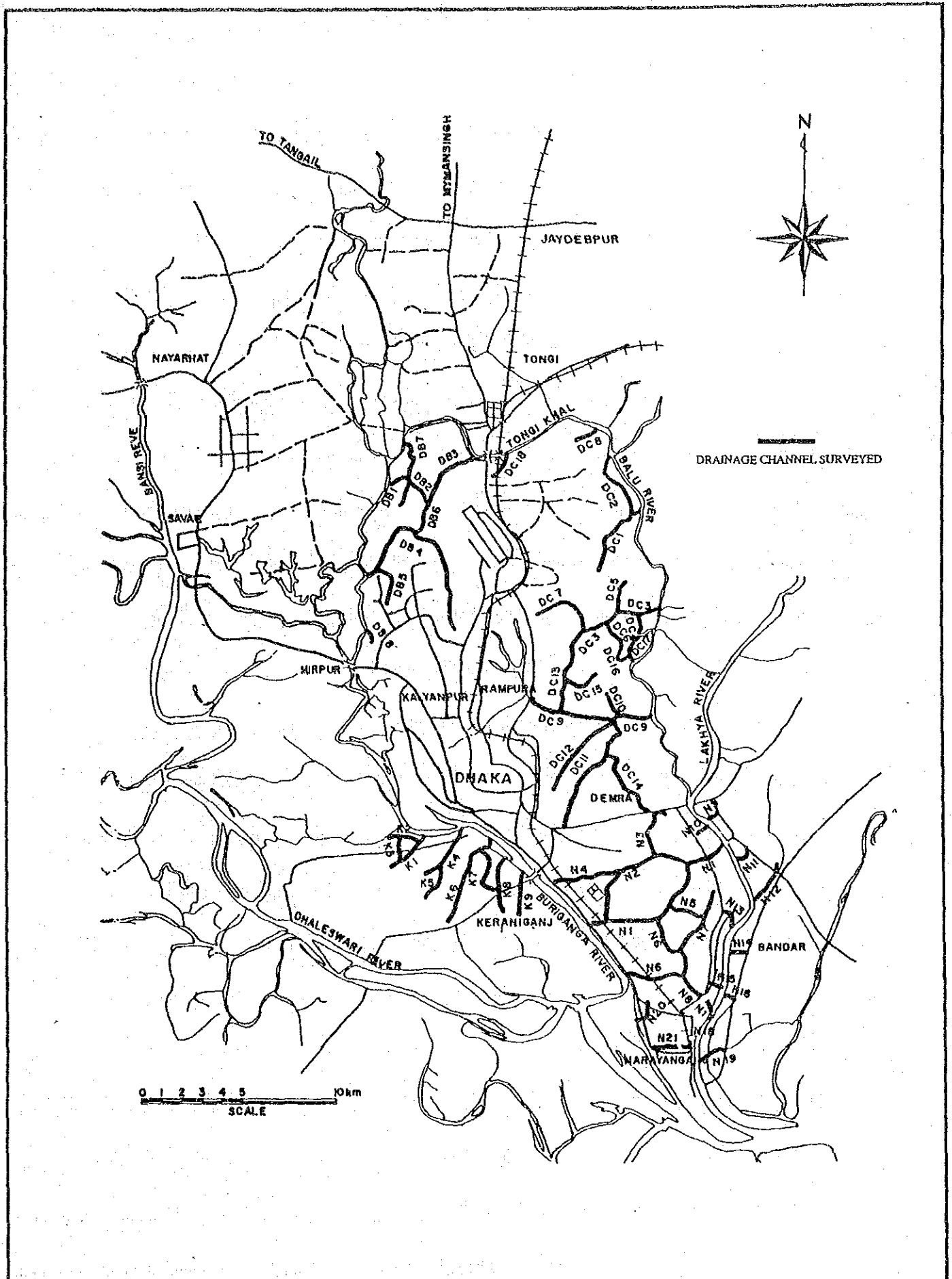


FIG. A.12

LOCATION OF LOGITUDINAL
AND CROSS-SECTIONAL SURVEY OF CANAL

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 B

SOCIO-ECONOMIC CONDITIONS

SUPPORTING REPORT B SOCIO-ECONOMIC CONDITIONS

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SUPPORTING REPORT B: SOCIO-ECONOMIC CONDITIONS

1. Socio-Economic Conditions at National Level

An overview of socio-economic conditions of Bangladesh was attempted in as much as they are related directly or indirectly to socio-economic conditions of the study area.

1.1 Population

1.1.1 Population and Its Growth

The last population census of Bangladesh was conducted in March, 1991. But, its results have not yet been published. Based on the series of population census in the past held every ten years or so, the population of Bangladesh is estimated as of 1990 at 113,005,000 according to Bangladesh Bureau of Statistics. (Refer to Table B.1.)

In terms of land area, Bangladesh consists of almost flat terrain of 143,999 square km. National average density of population is calculated at 785 persons per square km as of 1990.

Since 1981 in which the second latest population census was held, the population of Bangladesh is estimated to have grown at the average annual rate of 2.6%. During the decade starting in 1990 Bangladeshi population is forecast to grow at the average annual rate of 2.1% to 139,693,000 in 2000.

1.1.2 Structures of Population

According to population census 1981, age structure of the population of Bangladesh is such that the zero to 14 year group accounts for 46.6%, the 15 to 64 year group 50.0% and the 65 year and over group 3.4%. (Refer to Table B.1.)

It means that the productive age population and the dependent population are numerically equal.

Some more features of the results of population census 1981 are summarized hereunder.

In terms of the sex of population, male population statistically accounts for 51.6%.

Bangladesh is administratively divided into 21 Regions. The population of the Region of Dhaka to which the study area belongs occupies 11.5% of the total population.

86.7% of population is Moslem, 12.1% is Hindu, 0.6% Buddhist, 0.3% Christian and 0.3% others.

Urban versus rural ratio of population is 15:85.

1.2 Labor Force

1.2.1 General

According to population census 1981 the total labor force of Bangladesh was 25,900,000, which occupied 28.8% of the total population. In other words, one out of 3.5 persons was engaged in economic activities. Out of it, male labor force was 24,400,000 accounting for 94.2%.

Out of the total labor force, 25,300,000 was employed, and the balance of 600,000 or 2.3% was unemployed.

1.2.2 Sectoral Employment Structure

Looking at the employment structure of Bangladesh in 1985-86, one finds that 57.1% of the employed belonged to the primary industry. Likewise, 12.1% and 30.8% belonged to the secondary and tertiary industries.

In the secondary industry the manufacturing sector was dominant with the share of 9.9%, while in the tertiary industry the trade, hotels, restaurants sector and the community, personal service sector were dominant with the respective shares of 12.5% and 8.4%. (Refer to Table B.1.)

1.3 Economy

1.3.1 Gross Domestic Product and Its Growth

The gross domestic product (GDP) of Bangladesh in 1988-89 was Tk 659,598 million at market prices, which corresponds to US\$21,277 million at the exchange rate of US\$1 = TK 31. (Refer to Table B.2.)

During the last four years GDP of Bangladesh grew at the average annual rate of 3.6%.

In the same period implicit deflators of GDP grew at the average annual rate of 9.0%.

GDP of the Region of Dhaka in the said year was Tk 82,914 million at market prices, accounting for 12.6% of the national GDP.

1.3.2 Sectoral Industrial Structure

In 1988-89, GDP of the primary industry accounted for 37.2% of the national GDP. In the same way, GDP of the secondary and tertiary industries accounted for 15.4% and 47.4%, respectively. (Refer to Table B.2.)

The manufacturing and construction sectors dominated the secondary industry with the respective shares of 8.4% and 6.0%. In the tertiary industry major contributors were the professional and miscs., transport, storage and communication, housing services and trade services sectors with the respective shares of 12.7%, 10.9%, 9.1% and 8.3%.

1.3.3 Per Capita GDP

Per capita GDP of Bangladesh was Tk 5,701 in 1988-89. It corresponds to US\$184 at the exchange rate of US\$1 = Tk 31. (Refer to Table B.2.) For the sake of comparison it is to be noted that per capita GDP in the Region of Dhaka was Tk 6,275 or US\$202 in the same year.

During the last four years per capita GDP of Bangladesh grew at the average annual rate of 1.0%.

1.4 Annual Development Program

Annual Development Program (ADP) is the annualized national budget for development under the National Five-Year Plan.

According to the Third Five-Year Plan (1985-90) Tk 45,813 million was appropriated as ADP for 1989-90. The amount corresponds to 9.3% of the estimated national GDP for the same year.

In terms of sectors 25.0% of the total budget was allocated to the agriculture, water resources, rural development and institutions sector. Likewise, 24.0% and 16.2%

were allocated to the industry, power, natural resources, scientific and technological research sector and the transport, communication and mass media sector, respectively. (Refer to Table B.3.)

About 85% of the total ADP budget is financed by external resources and the balance is met by domestic resources.

2. Estimated Socio-Economic Conditions in the Study Area

In the Supporting Report C detailed analysis and reporting of the socio-economic conditions of the study area are done focusing on population and land use.

Also, detailed data on the income/profit, unit values, etc. of properties such as houses (households), shops and factories are presented in Supporting Report E so that they may be ultimately used for economic analysis.

In this section one finds a summarized description of some salient aspects of those reports.

2.1 Population, Households and Land Use

2.1.1 Population and Its Growth

The population of the study area is calculated at 4,157,209 in 1981 based on the population census conducted in the same year. In March, 1991 the latest population census was held and its results will be made known sooner or later.

The JICA Study Team estimated the population of the study area in 1990 at 6,534,316 based on the population census in 1981 as well as in older years. (Refer to Table B.4.)

The national population in 1990 is estimated at 113,005,000. It means that the population of the study area corresponds to 5.8% of the population of Bangladesh.

The population of the Region of Dhaka to which the study area belongs is estimated at 10,335,000 in 1990. Therefore, the population of the study area occupies 63.2% of the Regional population.

The study area lies over 827 square km of mostly low-lying land mass, accounting for 0.60% of national area. The average density of population in the study area is calculated at 7,897 persons per square km as of 1990, which contrasts with the average national population density of 785 persons per square km for the same year.

During the nine years from 1981 to 1990, the population of the study area is estimated to have grown at the average annual rate of 5.2%. It is projected that the population of the study area will reach 10,000,484 in 2000 growing at the average annual rate of 4.3% from 1990 to 2000. Also, it is projected that from 2000 on the population of the study area will grow at the average annual rate of 3.0% to 13,431,147 in 2010.

At the national level growth rate of population from 1981 to 1990 and from 1990 to 2000 is estimated at 2.6% and 2.1%, respectively. The population of the study area is, therefore, supposed to be growing at about twice the national rate. It bespeaks continuing urban concentration of population in this country.

2.1.2 Area-Wise Distribution of Population

The study area is divided into five areas, i.e. Greater Dhaka, Tongi, DND/Narayanganj, Keraniganj and Savar.

The Area of Greater Dhaka is the most urbanized with the majority of the study area population (4,472,633 or 68.4% as of 1990) being concentrated in this area of 27,528 ha (33.3%). The population density of the area is 162 persons per ha, which is about twice greater than that of the study area (79 persons/ha). (Refer to Table B.4.)

The second most urbanized area is DND/Narayanganj having the population of 1,110,616 or 17.0% over the area of 10,095 ha or 12.2%. The population density of the area is 110 persons per ha, which is by 39% higher than that of the study area.

The Area of Keraniganj has the population of 441,788 or 6.8% over the area of 17,035 ha or 20.6%. The density of population is 26 persons per ha, which is about one third the average level.

The Area of Savar has the second smallest population of 366,270 or 5.6% over the second largest area of 24,318 ha or 29.4%. It has the lowest population density of 15 persons per ha or about one fifth the average level.

The Area of Tongi has the smallest population of 143,009 or 2.2% over the smallest area of 3,768 ha or 4.5%. The density of population is 38 persons per ha or about one half the average level.

2.1.3 Households

The total number of households in the study area is estimated at 1,079,321 as of 1990. It is based on the estimation of the average number of members per household at 6.05, which derives from the results of the sampling questionnaire survey on flood damages. (Refer to Table B.4.)

Income class wise, No. of households belonging to the low income class with the monthly income of less than Tk 2,500 is estimated at 647,592 or 60%. Likewise, No. of households in the middle income class with the monthly income of not less than Tk 2,500, but less than Tk 7,000 will be 399,349 or 37%, and No. of high income class households with the monthly income of not less than Tk 7,000 will be 32,380 or 3%.

No. of members per household is estimated at 5.53 for the low income class. Similarly, it will be 6.76 for the middle income class and 7.83 for the high income class.

2.1.4 Land Use

The study area lies over the area of 82,744 ha. Out of it, as of 1990, 24,273 ha or 29.3% is made up of built-up area, 51,358 ha or 62.1% is occupied by agricultural land and 7,113 ha or 8.6% is covered with water. (Refer to Table B.4.)

Out of 24,273 ha of built-up area, 19,971 ha or 24.1% is urban, and the balance of 4,302 ha or 5.2% is rural.

The Area of Greater Dhaka has the highest urban built-up area ratio of 43.3%. The Area of DND/Narayanganj is placed second with the urban built-up area ratio of 41.9%. The Area of Tongi is placed third with 27.4%. The urban built-up area ratio of the Areas of Savar and Keraniganj is 8.5% and 4.3%, respectively.

77.8% of the Area of Savar and 76.9% of the Area of Keraniganj and 70.4% of the Area of Tongi are utilized for agriculture. The agricultural land ratio of the Areas of DND/Narayanganj and Greater Dhaka is 47.8% and 43.1%, respectively.

In the target year of 2010 the built-up area will be expanded by 75% to 42,533 ha or 51.4% of the study area, while the agricultural area will be curtailed by 37% to 32,304 ha or 39.0% of the study area.

2.2 Properties and Income/Profit

2.2.1 Properties and Their Area-Wise Distribution

The number of houses on household basis over the study area is estimated at 1,098,073 as of 1990 based on population census 1981. (This figure is slightly different from the one estimated based on the sampling questionnaire survey on flood damages.) (Refer to Table B.5.)

Likewise, the number of businesses/industries and institutions over the study area is estimated at 48,867 and 41,608, respectively for the same year.

Area-wise, Dhaka had 724,307 houses (66.0%), 33,132 businesses/industries (67.8%) and 30,275 institutions (72.8%). Narayanganj had 206,775 houses (18.8%), 9,034 businesses/industries (18.5%) and 7,380 institutions (17.7%). Keraniganj had 79,916 houses (7.3%), 2,595 businesses/industries (5.3%) and 635 institutions (1.5%). In Savar No. of houses was 60,615 (5.5%), No. of businesses/industries 1,066 (2.2%) and No. of institutions 1,190 (2.9%). In Tongi No. of houses was 26,460 (2.4%), No. of businesses/industries 3,040 (6.2%) and No. of institutions 2,128 (5.1%).

It is to be noted that in both Dhaka and Tongi the proportion of the number of businesses/industries and institutions as compared with the number of houses is greater than in other areas. Conversely, in both Keraniganj and Savar it is smaller than in other areas.

It is projected that No. of houses will increase at the average annual rate of 3.7% to 2,290,379 in 2010. No. of businesses/industries will increase at the average annual rate of 3.3% to 94,146 in 2010. Also, No. of institutions will increase at the average annual rate of 3.6% to 84,922 in the same year. (Refer to Table B.6.)

2.2.2 Values of Properties and Income/Profit

The information on the unit values and income/profit of properties is essential along with the data on the number of properties to estimate flood damages and income losses.

The following derives from the results of the sampling questionnaire survey on flood damages conducted by the JICA Study Team. (Refer to Table B.7 and B.8.)

The average present value of building(s) and household effects per household across the study area was found out to be Tk 93,319 and Tk 24,416, respectively as of February, 1991. When both are added together, they come to Tk 117,735.

Likewise, the average present value of building(s) and equipment & inventories per commercial establishment worked out at Tk 48,178 and Tk 136,074, respectively with combined values coming to Tk 184,252. The average No. of workers per establishment was 2.49.

The average present value of building(s) and equipment & inventories per industrial establishment worked out at Tk 488,483 and Tk 571,855, respectively adding up to Tk 1,060,338. 15.20 workers were employed on average per industrial establishment.

The average monthly income per household was calculated at Tk 3,381. Income class wise, a household belonging to the low income class earned Tk 1,813 on average per month. Likewise, the average monthly income per household in the middle income class was Tk 4,724. Also, the average monthly income per household in the high income class was Tk 18,151.

The average per capita household income was Tk 559. Income class wise, it was Tk 328 in the low class, Tk 699 in the middle class and Tk 2,318 in the high class.

The average monthly profit was Tk 19,940 per commercial establishment or Tk 8,008 per commercial worker. Also, the average monthly profit was Tk 163,053 per industrial establishment or Tk 10,727 per industrial worker.

Table B.1(1) Population and Labor Force in Bangladesh

1. Population and its Growth

Year	Population	Annual Growth Rate (%)
1961	55,222,663	2.26
1974	76,398,000	2.48
1981	89,912,000	2.32
1985	100,468,000	2.81
1990	113,005,000	2.38
1995	126,341,000	2.26
2000	139,693,000	2.03

2. Age Structure of 1981 Population

Age Group	Population	Percentage
0 - 14	40,600,000	46.6
15 - 64	43,565,000	50.0
65 +	2,955,000	3.4
Total	87,120,000	100.0

Table B.1(2) Population and Labor Force in Bangladesh

3. Employment Structure by Economic Sector in 1985-86

(Unit : Thousand)

Sector	Employment	Percentage
Agriculture, Forestry, Fishing	17,464	57.1
Mining, Quarrying	3	0.0
Manufacturing	3,019	9.9
Electricity, Gas, Water	38	0.1
Construction	646	2.1
Trade, Hotels, Restaurants	3,832	12.5
Transportation, Storage, Communication	1,321	4.3
Finance, Business, Services	367	1.2
Community, Personal Services	2,563	8.4
Household Sector	1,308	4.3
Total	30,562	100.0

Source: Statistical Yearbook of Bangladesh 1990

Table B.2 Gross Domestic Product of Bangladesh

1. GDP and its Growth

(Unit : Tk Million)

Item	1985 - 86	1986 - 87	1987 - 88	1988 - 89
GDP at constant factor cost (1984-85=100)	412,239	430,434	445,793	455,914
Annual growth rate (%)	4.22	4.06	2.99	2.27
Population (million)	101.7	104.1	106.6	109.1
Per capita GDP (Tk)	3,947	4,012	4,035	4,032
Annual growth rate (%)	1.67	1.65	0.57	-0.07

2. Industrial Structure by Sector in 1988-89

(Unit : Tk Million)

Sector	GDP	Percentage
Agriculture	245,392	37.2
Mining, Quarrying	4	0.0
Industry	55,608	8.4
Construction	39,262	6.0
Power, Gas, Water and Sanitary Services	6,719	1.0
Transport, Storage and Communication	71,774	10.9
Trade Services	55,015	8.3
Housing Services	59,866	9.1
Public Admn. and Defence	29,203	4.4
Banking and Insurance	13,126	2.0
Professional and Miscs.	83,629	12.7
GDP at Market Prices	659,598	100.0
GDP at Current Factor Cost	621,997	-
Population (million)	109.1	-
Per Capita GDP at f.c. (Tk)	5,701	-

Source: Statistical Yearbook of Bangladesh 1990

Table B.3 Sectoral Allocation of ADP for 1989-90

(Unit : Tk Million)

Sector	Amount	Percentage
Agriculture, Water Resources, Rural Development and Institutions	11,559.7	25.00
Industry, Power, Natural Resources, Scientific and Technological Research	11,020.0	24.00
Transport, Communication and Mass Media	7,421.8	16.20
Housing and Physical Planning & Water Supply	1,794.8	3.90
Education, Religious Affairs, Sports and Culture	2,736.0	6.00
Health, Population Control, Family Planning, Social Welfare, Women Affairs and Youth Development	3,586.4	7.80
Development of Upazila Infrastructure and Assistance to Upazila Parishad	2,000.0	4.40
Self-financing Scheme of Autonomous Bodies	2,570.8	5.60
Others	3,264.4	7.10
Total	45,813.0	100.00

Source: Statistical Yearbook of Bangladesh 1990

Table B.4(1) Summary of Population and Land Use in the Study Area

1. Population and its Growth

Item	1981	1990	2000	2010
Population	4,125,864	6,534,314	10,000,484	13,431,147
Annual Growth Rate (%)	-	5.2	4.3	3.0

2. Distribution of 1990 Population by Area

Area	Land Area (ha)	Population	Population Density (/ha)
Greater Dhaka	27,527 (33.6%)	4,472,633 (68.4%)	162
Tongi	3,768 (4.6%)	143,009 (2.2%)	38
DND/Narayanganj	9,895 (12.1%)	1,110,616 (17.0%)	112
Keraniganj	16,385 (20.0%)	441,788 (6.8%)	27
Savar	24,318 (29.7%)	366,270 (5.6%)	15
Total	81,892 (100.0%)	6,534,316 (100.0%)	80

3. No. of Households in 1990 by Income Class

Item	Income Class			Total (Average)
	Low	Middle	High	
No. of Members Per Household	5.53	6.76	7.83	6.05
Ratio (%)	60	37	3	100
No. of Households	647,592	399,349	32,380	1,079,321

Table B.4(2) Summary of Population and Land Use in the Study Area

4. Land Use in 1990 by Area

(Unit : ha)

Area	Total	Built-up			Agricultural	Water Surface
		Sub-Total	Urban	Rural		
Greater Dhaka	27,527 (100.0%)	11,683 (42.4%)	10,880 (39.5%)	803 (2.9%)	12,157 (44.2%)	3,687 (13.4%)
Tongi	3,768 (100.0%)	1,057 (28.1%)	765 (20.3%)	292 (7.7%)	2,654 (70.4%)	57 (1.5%)
DND/Narayanganj	9,895 (100.0%)	4,601 (46.5%)	2,819 (28.5%)	1,782 (18.0%)	4,766 (48.2%)	528 (5.3%)
Keraniganj	16,385 (100.0%)	2,228 (13.6%)	682 (4.2%)	1,546 (9.4%)	12,494 (76.3%)	1,663 (10.1%)
Savar	24,318 (100.0%)	3,030 (12.5%)	1,290 (5.3%)	1,740 (7.2%)	19,883 (81.8%)	1,406 (5.8%)
Total	81,892 (100.0%)	22,598 (27.6%)	16,436 (20.1%)	6,163 (7.5%)	51,954 (63.4%)	7,340 (9.0%)

Source: JICA

Table B.5(1) No. of Properties by Zone by Type of Properties in 1980

(Unit: Number)

Zone No.	Name of Zones	Houses	Businesses/ Industries	Institutions
1	1	11,322	389	217
2	2	20,835	491	369
3	3	11,865	413	267
4	4	8,811	379	286
5	5	10,743	436	128
6	6	4,708	225	39
7	7	8,064	204	774
8	8	7,204	203	403
9	9	6,868	538	573
10	10	14,558	273	93
11	11	8,599	262	102
12	12	19,824	774	366
13	13	5,872	262	221
14	14	2,506	199	41
15	15	4,779	554	92
16	16	14,721	1,237	286
17	17	3,063	840	103
18	18	1,763	82	102
19	19	6,426	606	393
20	20	11,439	846	278
21	21	7,663	440	394
22	22	4,064	642	240
23	23	6,618	676	198
24	24	3,518	741	563
25	25	7,226	615	479
26	26	13,474	519	387
27	27	9,120	962	285
28	28	12,030	662	401
29	29	8,516	414	366
30	30	11,236	330	507
31	31 Dhaka	14,771	645	900
32	32 Dhaka	2,867	135	10
33	33 Dhaka	11,111	455	195
34	34	21,146	551	1,993
35	35	9,940	635	539
36	36	13,071	387	193
37	37	5,345	157	85
38	38	10,523	528	133
39	39	19,676	447	447
40	40	7,055	224	182
41	41	9,149	155	147
42	42	9,580	637	810
43	43	7,066	534	499
44	44	7,998	632	1,098
45	45	6,698	166	1,757
46	46	9,827	380	372
47	47	14,746	667	565
48	48	18,878	1,265	1,951
49	49	4,764	875	62
50	50	9,594	779	430

Note: No. is on household basis.

Source: Population Census 1981 and JICA

Table B.5(2) No. of Properties by Zone by Type of Properties in 1990

(Unit: Number)

Zone No.	Name of Zones	Houses	Businesses/ Industries	Institutions
51	51	11,862	449	1,007
52	52	12,754	328	300
53	53	9,847	505	715
54	54	27,213	641	999
55	55	41,560	985	383
56	56	41,473	1,588	772
57	Gulshan 57	9,382	18	53
58	Cantonment Ward-1	16,579	938	1,946
59	Cantonment Ward-2	8,134	258	156
60	Cantonment Ward-3	5,133	168	110
61	Sultanganj	12,986	516	259
62	Harirampur	4,850	37	34
63	Dakshin Khan Cantt.	13,422	763	1,578
64	Uttar Khan	4,067	1	7
65	Dakshin Khan Gulshan	8,117	226	29
66	Beraid Gulshan	4,022	3	8
67	Beraid Demra	1,328	15	5
68	Demra	8,806	175	420
69	Matuail Dhaka	1,528	50	169
31	31 Nara.	1,641	72	100
32	32 Nara.	25,805	1,219	91
33	33 Nara.	7,408	303	130
69	Matuail Nara.	29,842	982	3,305
70	Shyampur	19,866	1,033	1,026
71	N 1	3,759	165	148
72	N 2	3,092	62	97
73	N 3	4,696	140	56
74	N 4	7,669	329	147
75	N 5	5,139	846	230
76	N 6	7,119	442	51
77	N 7	3,365	92	47
78	N 8	4,336	387	59
79	N 9	4,049	155	137
80	N10	3,090	64	95
81	N11	4,277	146	90
82	N12	2,612	81	212
83	Tarabo	6,122	144	32
84	Kachpur	3,460	75	11
85	Siddhirganj	7,470	427	254
86	Simulpara	13,743	787	467
87	Godnail	4,328	168	16
88	Kutubpur	13,164	348	236
89	Fatullah	9,656	375	93
90	Enayetnagar	5,199	162	235
91	Kashipur	5,867	32	13
92	Konda	6,715	130	136
93	Teguria	4,420	16	14
94	Subhadya	21,302	411	225
95	Zinjira	17,677	1,574	161
96	Kalindi	4,279	78	23

Note: No. is on household basis.

Source: Population Census 1981 and JICA

Table B.5(3) No. of Properties by Zone by Type of Properties in 1990

(Unit: Number)

Zone No.	Name of Zones	Houses	Businesses/ Industries	Institutions
97	Basta	4,652	62	12
98	Sakta	6,372	152	20
99	Rohitpur	3,912	54	17
100	Taranagar	4,912	26	17
101	Kalatia	5,674	92	9
102	Amin Bazar	4,333	88	40
103	Kaundia	4,355	4	51
104	Hazratpur	2,568	12	9
105	Bhakurta	6,092	12	4
106	Tetuljhora	4,313	74	20
107	Banagram	3,674	1	50
108	Biralia	3,545	5	20
109	Savar	13,399	431	820
110	Ashulia	3,806	140	18
111	Pathalia	5,463	242	90
112	Dhamsona	2,822	28	11
113	Yearpur	3,043	1	22
114	Kashimpur	3,203	27	36
115	Tongi	26,161	3,037	2,127
116	Gachha	299	4	1
	TOTAL	1,098,073	48,867	41,608

Summary

Name of Areas	Houses	Businesses/ Industries	Institutions
Dhaka	724,307	33,132	30,275
Narayanganj	206,775	9,034	7,380
Keraniganj	79,918	2,595	635
Savar	60,615	1,066	1,190
Tongi	26,460	3,040	2,128
TOTAL	1,098,073	48,867	41,608

Note: No. is on household basis.

Source: Population Census 1981 and JICA

Table B.6(1) No. of Properties by Zone by Type of Properties in 2010

(Unit: Number)

Zone No.	Name of Zones	Houses	Businesses/ Industries	Institutions
1	1	17,064	587	327
2	2	34,729	818	616
3	3	17,855	622	402
4	4	15,745	677	511
5	5	24,573	998	292
6	6	8,932	427	74
7	7	11,771	298	1,130
8	8	10,757	303	602
9	9	10,187	798	851
10	10	24,673	463	158
11	11	15,788	482	187
12	12	15,856	619	293
13	13	13,436	598	505
14	14	15,821	1,257	260
15	15	6,052	702	116
16	16	9,622	809	187
17	17	3,914	1,074	132
18	18	5,129	239	295
19	19	7,687	725	470
20	20	10,615	785	258
21	21	6,931	398	356
22	22	3,598	568	212
23	23	5,069	518	152
24	24	3,372	710	539
25	25	9,823	836	651
26	26	10,001	385	287
27	27	5,190	548	162
28	28	14,395	793	480
29	29	12,656	615	544
30	30	17,524	514	792
31	31 Dhaka	27,729	1,211	1,689
32	32 Dhaka	5,966	282	21
33	33 Dhaka	16,890	691	297
34	34	38,701	1,008	3,648
35	35	14,737	941	799
36	36	22,052	653	325
37	37	7,758	228	124
38	38	17,288	868	219
39	39	31,405	713	713
40	40	14,220	451	367
41	41	13,461	228	217
42	42	14,083	937	1,191
43	43	10,668	807	754
44	44	11,950	944	1,641
45	45	10,070	249	2,641
46	46	14,381	556	545
47	47	21,853	988	837
48	48	28,428	1,905	2,938
49	49	7,088	1,302	92
50	50	14,264	1,158	639

Note: No. is on household basis.

Source: Population Census 1981 and JICA

Table B.6(2) No. of Properties by Zone by Type of Properties in 2010

(Unit: Number)

Zone No.	Name of Zones	Houses	Businesses/ Industries	Institutions
51	51	17,757	672	1,507
52	52	19,092	491	450
53	53	14,686	754	1,066
54	54	61,290	1,443	2,249
55	55	79,403	1,882	732
56	56	83,203	3,186	1,549
57	Gulshan 57	54,358	103	308
58	Cantonment Ward-1	33,053	1,870	3,881
59	Cantonment Ward-2	19,803	627	380
60	Cantonment Ward-3	40,638	1,327	871
61	Suitanganj	35,357	1,403	705
62	Harirampur	38,871	307	282
63	Dakshin Khan Cantt.	32,021	1,820	3,765
64	Uttar Khan	48,315	16	81
65	Dakshin Khan Gulshan	50,286	1,398	182
66	Beraid Gulshan	16,021	11	32
67	Beraid Demra	2,232	25	8
68	Demra	18,948	377	904
69	Matuail Dhaka	35,288	1,162	3,909
31	31 Nara.	3,081	135	188
32	32 Nara.	53,215	2,515	187
33	33 Nara.	11,059	452	195
69	Matuail Nara.	65,535	2,157	7,259
70	Shyampur	42,552	2,212	2,198
71	N 1	7,584	332	289
72	N 2	4,970	100	156
73	N 3	9,981	297	119
74	N 4	11,237	482	216
75	N 5	7,484	1,233	335
76	N 6	10,468	650	75
77	N 7	4,951	135	69
78	N 8	6,353	568	86
79	N 9	14,330	549	485
80	N10	5,029	103	155
81	N11	6,971	238	146
82	N12	6,279	194	510
83	Tarabo	13,539	318	70
84	Kachpur	15,156	329	49
85	Siddhirganj	11,777	672	401
86	Simulpara	21,721	1,244	737
87	Godnail	37,582	1,459	137
88	Kutubpur	35,453	936	635
89	Fatullah	25,246	980	244
90	Enayetnagar	19,729	615	892
91	Kashipur	25,622	142	57
92	Konda	16,813	325	342
93	Teguria	16,882	60	55
94	Subhadya	33,762	651	357
95	Zinjira	26,291	2,342	240
96	Kalindi	9,416	172	50

Note: No. is on household basis.

Source: Population Census 1981 and JICA

Table B.6(3) No. of Properties by Zone by Type of Properties in 2010

(Unit: Number)

Zone No.	Name of Zones	Houses	Businesses/ Industries	Institutions
97	Basta	7,622	101	19
98	Sakta	10,441	249	32
99	Rohitpur	6,410	88	28
100	Taranagar	8,048	43	28
101	Kalatia	9,297	150	15
102	Amin Bazar	6,390	130	59
103	Kaundia	6,442	6	75
104	Hazratpur	7,012	32	24
105	Bhakurta	9,980	19	6
106	Tetuljhora	7,371	127	34
107	Banagraa	6,019	2	82
108	Biralia	5,808	9	32
109	Savar	47,859	1,540	2,930
110	Ashulia	6,236	229	30
111	Pathalia	9,422	417	155
112	Dhamsona	8,039	80	30
113	Yearpur	4,985	2	37
114	Kashimpur	7,498	62	84
115	Tongi	121,474	14,100	9,875
116	Gachha	482	6	1
	TOTAL	2,290,378	94,146	84,922

Summary

Name of Areas	Houses	Businesses/ Industries	Institutions
Dhaka	1,413,478	54,157	54,399
Narayanganj	476,902	19,044	15,902
Keraniganj	144,983	4,182	1,167
Savar	133,060	2,656	3,577
Tongi	121,956	14,106	9,877
TOTAL	2,290,379	94,146	84,922

Note: No. is on household basis.

Source: Population Census 1981 and JICA

Table B.7 Unit Values of Properties

(Unit : Tk)

Property	Building(s)	Household Effects	Equipment & Inventories	Total	No. of Household Members/Workers
House	93,319	24,416	-	117,735	6.05
Shop	48,178	-	136,074	184,252	2.49
Factory	488,483	-	571,855	1,060,338	15.20

Table B.8 Income and Profit

1. Monthly Household Income

(Unit : Tk)

Item	Income Class			Average
	Low	Middle	High	
Household Income	1,813	4,725	18,151	3,381
Per Capita	328	699	2,318	559

2. Monthly Profit

(Unit : Tk)

Item	Shop	Factory
Profit	19,940	163,053
Per Worker	8,008	10,727

Source: JICA

