TABLE I-3-6 SOIL MAPPING UNIT, PERCENTAGE AND AREA (2/3)

STUDY AREA

Mapping unit	Physio-graphy	Area	Non. Agri.	Agricultural land				Irrigation suitable
				Land type	Percent	Soil	Percent	
7	Ganges flood-plain (Cal.)	5,470	Minor	Highland	90	Sara Gopalpur	60 30	Moderately suitable
				Medium highland	10	Ishurdi	10	
8		930	50	Highland irregular	85	Sara Gopalpur	75 10	Marginally suitable
				Medium highland	10	Gopalpur	10	
9		310	Nil	Medium highland	100	Mehendigonj	100	Moderately suitable
10		2,040	Nil	Medium highland	80	Ghior Garuri	50 30	Highly suitable
				Medium lowland	20	Ghior Garuri	10 10	
11		7,100	Nil	Medium lowland	70	Santhia Ghior	60 10	Highly suitable
				Lowland	30	Ghior Snthia	20 10	
12	(Non. Cal.)	1,050	60	Highland irregular	85	Tahirpur	85	Marginally suitable
				Medium highland	10	Teghar	10	

TABLE I-3-6 SOIL MAPPING UNIT, PERCENTAGE AND AREA (3/3)

STUDY AREA

Mapping unit	Physio-graphy	Area	Non. Agri.	Agricultural land.				Irrigation suitable
				Land type	Percent	Soil	Percent	
13		520	Nil	Medium highland	100%	Teghar Maria	80% 20	Highly suitable
14		150	Nil	Medium highland	100	Gulai	100	Highly suitable
15	Tista flood-plain	1,280	Nil	Medium lowland	80	Digli Jaonia	60 20	Highly suitable
				Lowland	20	Jaonia	20	
16		3,350	Nil	Lowland	80	Jaonia	80	Highly suitable
				Medium lowland	20	Jaonia	20	
Sub total		136,070	*3,830					
Micell-aneous	Settle-ments	11,030	15,730					
	Ponds	1,940						
	Water bodies	1,740						
	Rivers	1,020						
Total of Project area		151,800						

Remarks : 3,830 $\frac{2,300 \text{ settlements}}{1,530 \text{ ponds}}$

TABLE I-3-7 SOIL MAPPING UNIT, PERCENTAGE AND AREA (1/3)

PROJECT AREA

Mapping unit	Physio-graphy	Area	Non. Agri.	Agricultural land				Irrigation suitable
				Land type	Percent	Soil	Percent	
1	Barind Tract	12,940	Minor	Highland level	100%	Nijhuri Amnura Lauta	70% 20 10	Highly suitable
2		24,500	1,230	Highland undulating	95	Nijhuri Amnura Atahar Nachol	60 20 10 5	Moderately suitable
3		1,540	Nil	Highland slopping	100	Amnura Nachol Nijhuri	60 30 10	Moderately suitable
4		2,780	140	Highland rolling	95	Nijhuri Atahar Nachol Anmura	50 20 15 10	Marginally suitable
5		2,400	Nil	Highland valley	100	Nachol	100	Moderately suitable
6		4,770	Nil	Highland valley	60	Nachol	60	Highly suitable
				Medium highland valley	40	Pauli Nachol	30 10	

TABLE I-3-7 SOIL MAPPING UNIT, PERCENTAGE AND AREA (2/3)

PROJECT AREA

Mapping unit	Physio-graphy	Area	Non. Agri.	Agricultural land				Irrigation suitable
				Land type	Percent	Soil	Percent	
7	Ganges flood-plain (Cal.)	4,460	Minor	Highland	90	Sara Gopalpur	60 30	Moderately suitable
				Medium highland	10	Ishurdi	10	
8		480	20	Highland irregular	85	Sara Gopalpur	75 10	Marginally suitable
				Medium highland	10	Gopalpur	10	
9		300	Nil	Medium highland	100	Mehendigonj	100	Moderately suitable
10		1,970	Nil	Medium highland	80	Ghior Garuri	50 30	Highly suitable
				Medium lowland	20	Ghior Garuri	10 10	
11		5,730	Nil	Medium lowland	70	Santhia Ghior	60 10	Highly suitable
				Lowland	30	Ghior Snthia	20 10	
12	(Non. Cal.)	1,070	50	Highland irregular	85	Tahirpur	85	Marginally suitable
				Medium highland	10	Teghar	10	

TABLE I-3-7 SOIL MAPPING UNIT, PERCENTAGE AND AREA (3/3)

PROJECT AREA

Mapping unit	Physio-graphy	Area	Non. Agri.	Agricultural land.				Irrigation suitable
				Land type	Percent	Soil	Percent	
13		470	Nil	Medium highland	100%	Teghar Maria	80% 20	Highly suitable
14		140	Nil	Medium highland	100	Gulai	100	Highly suitable
15	Tista flood-plain	480	Nil	Medium lowland	80	Digli Jaonia	60 20	Highly suitable
				Lowland	20	Jaonia	20	
16		2,340	Nil	Lowland	80	Jaonia	80	Highly suitable
				Medium lowland	20	Jaonia	20	
Sub total		66,370	*1,440					
	Settle-ments	8,310	10,630					
	Ponds	720						
	Water bodies	1,190						
	Rivers	410						
Total of Project area		77,000						

Remarks : *1,440 = 860 settlements + 580 ponds

FIGURE I -3-3 PHOTO - INT. SOIL AND LAND TYPE OF STUDY AREA

NORTH RAJSHAHI IRRIGATION PROJECT

FIGURE I-3-3 PHOTO-INT. SOIL AND LAND TYPE OF STUDY AREA

LEGEND

Mapping unit	Physiography	Area	Non Agri.	Agricultural land				Irrigation suitability
				Land type	Percent	Soils	Percent	
1	Barind Tract	23,920	Minor	Highland level	100	Nijhuri Amnura Loam	70 20 10	Highly suitable
2	"	58,270	3,070	Highland Undulating	95	Nijhuri Amnura Aleher Nachal	60 20 10 5	Moderately suitable
3	"	3,310	Nil	Highland slopping	100	Amnura Nachal Nijhuri	60 30 10	Moderately suitable
4	"	12,350	650	Highland rolling	95	Nijhuri Aleher Nachal Amnura	50 20 15 10	Marginally suitable
5	"	6,900	Nil	Highland valley	100	Nachal	100	Moderately suitable
6	"	9,120	Nil	Highland valley Medium high land valley	60 40	Nachal Pauli Nachal	60 30 10	Highly suitable
7	Ganges flood plain (Col.)	5,470	Minor	Highland Medium highland	90 10	Sara Gopalpur Isherdi	60 30 10	Moderately suitable
8	"	930	50	Highland Medium highland	85 10	Sara Gopalpur Gopalpur	75 10 10	Marginally suitable
9	"	310	Nil	Medium highland	100	Mahendigonj	100	Moderately suitable
10	"	2,040	Nil	Medium highland Medium lowland	80 20	Ghior Gurwi Ghior Santhia	50 30 10 10	Highly suitable
11	"	7,100	Nil	Medium lowland Lowland	70 30	Santhia Ghior Ghior Santhia	60 10 20 10	Highly suitable
12	Non. Col.	1,050	60	Highland irregular Medium highland	85 10	Tanir pur Teghar	85 10	Marginally suitable
13	"	520	Nil	Medium highland	100	Teghar Merie	80 20	Highly suitable
14		150	Nil	Medium highland	100	Gulai	100	Highly suitable
15	Tista flood plain.	1,280	Nil	Medium lowland Lowland	80 20	Digli Joonie Joonie	60 20 20	Highly suitable
16	"	3,350	Nil	Lowland Medium lowland	80 20	Joonie Joonie	80 20	Highly suitable
Sub total		136,070	3,830					
Miscellaneous	Settlements	11,030	15,730					
	Water bodies	1,940						
	Rivers	1,740						
	Ponds	1,020						
Total of project area		151,900						

Remarks : $3,830 - \frac{2,300}{1,530} - \frac{\text{Settlements}}{\text{ponds}}$

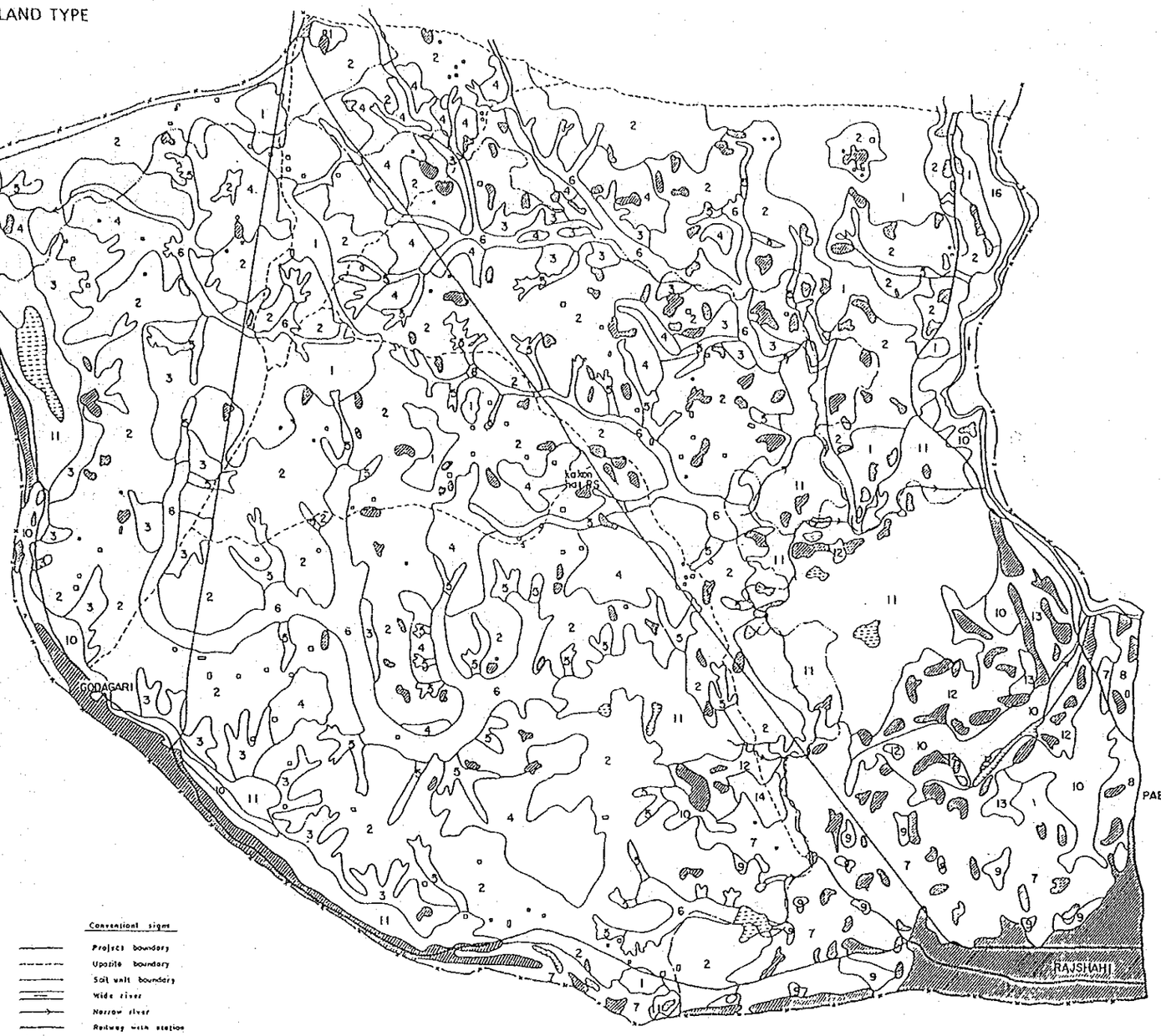
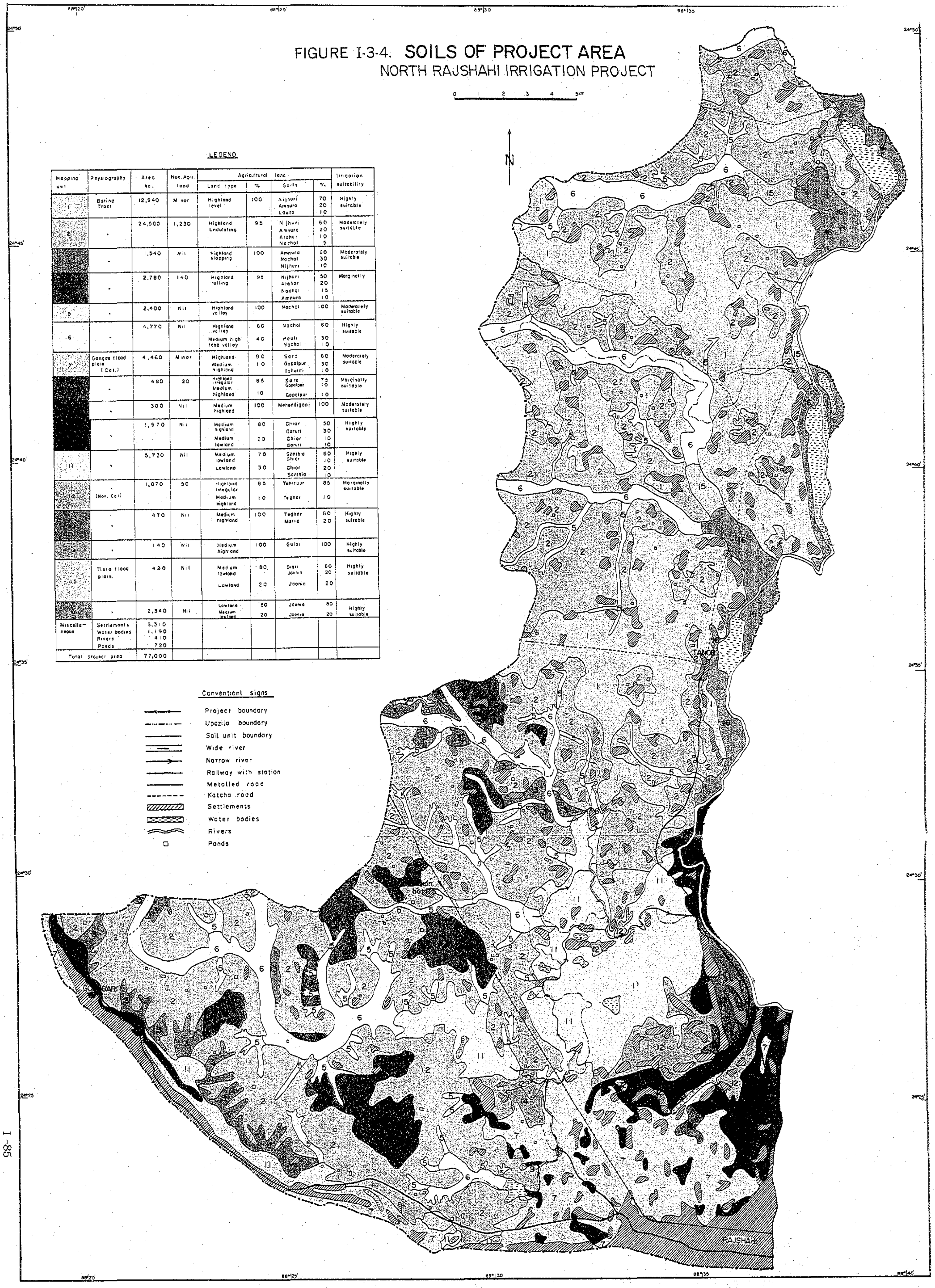


FIGURE I-3-4. SOILS OF PROJECT AREA
NORTH RAJSHAHI IRRIGATION PROJECT



LEGEND

Mapping unit	Physiography	Area ha.	Non. Agri. land	Agricultural land: Land type	%	Soils	%	Irrigation suitability
1	Barind Tract	12,940	Minor	Highland level	100	Nijhuri Amnura Laura	70 20 10	Highly suitable
2	"	24,500	1,230	Highland Undulating	95	Nijhuri Amnura Atahar Nachol	60 20 10 5	Moderately suitable
[illegible]	"	1,540	Nil	Highland slopping	100	Amnura Nachol Nijhuri	60 30 10	Moderately suitable
[illegible]	"	2,780	140	Highland rolling	95	Nijhuri Atahar Nachol Amnura	50 20 15 10	Marginally
5	"	2,400	Nil	Highland valley	100	Nachol	100	Moderately suitable
6	"	4,770	Nil	Highland valley Medium high land valley	60 40	Nachol Pauli Nachol	60 30 10	Highly suitable
7	Ganges flood plain (Cal.)	4,460	Minor	Highland Medium highland	90 10	Sara Gopalpur Ishurdi	60 30 10	Moderately suitable
[illegible]	"	480	20	Highland irregular Medium highland	85 10	Sara Gopalpur Gopalpur	75 10 10	Marginally suitable
[illegible]	"	300	Nil	Medium highland	100	Mehendiganj	100	Moderately suitable
[illegible]	"	1,970	Nil	Medium highland Medium lowland	80 20	Ghior Garuri Ghior Garuri	50 30 10 10	Highly suitable
11	"	5,730	Nil	Medium lowland Lowland	70 30	Santhia Ghior Ghior Santhia	60 10 20 10	Highly suitable
12	" (Non. Cal)	1,070	50	Highland irregular Medium highland	85 10	Tahirpur Teghar	85 10	Marginally suitable
[illegible]	"	470	Nil	Medium highland	100	Teghar Marria	80 20	Highly suitable
14	"	140	Nil	Medium highland	100	Gulai	100	Highly suitable
15	Tista flood plain.	480	Nil	Medium lowland Lowland	80 20	Diara Joania Joania	60 20 20	Highly suitable
16	"	2,340	Nil	Lowland Medium lowland	80 20	Joania Joania	80 20	Highly suitable
Miscellaneous	Settlements Water bodies Rivers Ponds	8,310 1,190 410 720						
Total project area		77,000						

Conventional signs

- Project boundary
- Upazila boundary
- Soil unit boundary
- Wide river
- Narrow river
- Railway with station
- Metalled road
- Katcha road
- Settlements
- Water bodies
- Rivers
- Ponds

4 LAND SUITABILITY CLASSIFICATION

4-1 Basic Consideration on the Land Suitability Classification

Land suitability classification can be defined as grouping of specific areas of land for specific uses. It reflects degree of suitability such as S_1 - highly suitable, S_2 - moderately suitable, S_3 - marginally suitable and N - non suitable.

Land Suitability Classes

a) S_1; Highly suitable : Land having no significant limitation to sustained application of given use or only minor limitations that will not significantly reduce productivity or benefits and will not raise input above an acceptable level.

b) S_2; Moderately suitable : Land having limitations which in aggregate are moderately severe for sustained application of a given use; the limitations will reduce productivity or benefits and increase required inputs to the extent that the overall advantage to be gained from the uses, although still attractive, will be appreciably inferior to that expected on class S_1 land.

c) S_3; Marginally suitable : Land having limitations which in aggregate are severe for sustained application of a given use and will so reduce productivity or benefits, or increase required inputs, that this expenditure will be only marginally justified.

d) N; Non suitable : It contains two classes within the order not suitable. One is N_1, currently not suitable : Land having limitations which may be surmountable in time but which cannot be corrected with existing knowledge at currently acceptable cost; the limitations are so severe as to preclude successful sustained use of the land in the given manner. The other is N_2, permanently not suitable : Land having limitations which appear so severe as to preclude any possibilities of successful sustained use of the land in the given manner.

Land suitable classification might be done taking into account the present state of land or the improvement such as provision of irrigation, land leveling and others. The present classification is done depending on the provision of irrigation. Land suitability classification of the

project area is done in accordance with of land characteristics/qualities and crop requirements.

4-2 Land Characteristics/Qualities

Land characteristics are inherent properties of land that can be measured such as soil texture, while land qualities are functional properties of land which influences for the suitability of a specific land such as availability of moisture. Eight land characteristics/qualities are considered for the project area as shown in the TABLE I-4-1.

4-3 Crop Requirement

Crop requirement refers to the land characteristics/qualities that determine the productivity and managing conditions of specific crop. Ten (10) crops are taken into consideration in the project area and their requirements are presented in the TABLE I-4-2.

4-4 Land Suitability Classification

Land suitability classes are determined in comparing with the land characteristics/qualities of different mapping units with the requirement of selected crops. In some cases personal experience is given proper consideration, additionally to the criteria for selecting some crop in some specific classes. The suitability in the project area are recognized three classes, e.g., highly suitable, moderately suitable and marginally suitable.

4-5 Land Suitability Mapping Unit

In all nine (9) land suitability mapping units are selected. Some crops are placed in the highly suitable class in each mapping unit while other crops are placed in moderately and marginally suitable classes. Land suitability mapping units, soil mapping unit and their area are shown in the TABLE I-4-3. The land suitability map in the Project area is shown in the FIGURE I-4-1.

Description of Land Suitability Mapping Unit

Mapping unit No. 1 : soil unit No. 1: Nijhuri - Amnura, level phase, 12,940ha.

This unit belongs to the level Barind tract. The area is above flood level and rain water is kept in the field by small boundary bunds for growing T.aman crop. This unit belongs to land use mapping unit 4a, mainly single with some double cropped land. This unit is highly suitable for T. aus., T. aman and boro and moderately suitable for wheat and sugarcane. With irrigation the soils of this unit could produce high yield of two transplanted rice crops including boro or one rice crop and wheat per year. This soils are highly suitable for irrigation but all the year round soils should not kept wet.

Mapping unit No. 2 : soil unit No. 6 : Nachol - Pauli, 4,770 ha;

This unit mainly comprises broad valleys lying in between the uplands. Major part, about 60 percent, is not flooded but rest 40 percent is flooded by rain water of less than 1 meter in the rainy season. This unit belongs to land use mapping unit 5a. Low organic matter, low nutrient content and shortage of moisture restrict the cultivation of rabi crops. With irrigation and application of organic and chemical fertilizers along with improved seeds and cultural practices this soils could produce high yield of two transplanted rice crops per year. This unit is highly suitable for T. aus, T. aman and boro and moderately suitable for wheat. This soils are highly suitable for irrigation but it should not kept wet round the year.

Mapping unit No. 3 : soil unit No. 10, 13, 14; soil unit No. 10 : Ghior - Garuri, medium highland, soil unit No. 13 : Teghar - Maria, medium highland, soil unit No. 14 : Gulai, medium highland, 2,580 ha;

This unit is shallowly to moderately deeply flooded by rain or river water in the rainy season. This unit comprises basins, low ridges and inter ridge depressions and belongs to medium highland. This unit belongs to the land use mapping units 1a, 4c, 5b. Low organic material, low nutrient content and shortage of soil moisture in the rabi season restrict

the cultivation of rabi crops. Especially in the soils of unit 1a, wet in the early and shortage of moisture in the late rabi season do not allow any rabi crops to grow except khesari. This unit are highly suitable for boro and moderately suitable for T. aus and T. aman.

Mapping unit No. 4 ; soil unit No. 11, 15; soil unit No. 11 : Santhia - Ghior, medium low/lowland, No. 15 : Digli - Jaonia, medium lowland, 6,210 ha;

The unit comprises basins which are moderately deeply to deeply flooded by rain or river water. This unit belongs to land use mapping unit 5C, predominantly single cropped land. Moderately deep to deep flooding restricts the cultivation of T. aman. Early wetness and late droughtiness also do not allow to grow any rabi crop except khesari. With irrigation this soils could produce high yield boro. This soils are highly suitable for irrigation.

Mapping unit No. 5; soil unit No. 2, 3, 5; soil unit No. 2 : Nijhuri - Amnura, undulating phase, soil unit No. 3 : Amnura - Nachol, slopping phase, soil unit No. 5 : Nachol, highland, 28,440 ha;

This unit comprises landscapes of undulating and slopping topography and shallow valleys. The area is not flooded but rain water is kept in the field by small boundary bunds.

This unit belongs to land use mapping unit 4b, 5a, 5b. Low organic matter, low nutrient content and shortage of available moisture in the rabi season restrict the cultivation of rabi crops. Droughtiness sometimes even affects kharif rice crop. Undulating topography is an additional limitation. With small scale irrigation this soil could produce two rice crops per year or one rice crop followed by wheat. This soil is moderately suitable for irrigation due to its undulating.

Mapping unit No. 6 ; soil unit No. 9, 16; soil unit No. 9 : Mehendigonj, medium highland, soil unit No. 16 : Jaonia, lowland, 2,640 ha;

The area comprises basins which are shallowly to deeply flooded by rain and river water during the monsoon season. This unit belongs to the land use mapping unit 1b, predominantly double cropped land and unit 5C,

predominantly single cropped land. It is moderately suitable for boro, because flooding in the rainy season restricts the cultivation of T. aman. Wet in the early and shortage of moisture in the late rabi reason do not allow to grow any other rabi crops except khesary which is grown as a relay crop. With irrigation this soils could produce high yield boro.

Mapping unit No. 7 ; soil unit No. 7 : Sara - Gopalpur, level phase, 4,460 ha;

This unit occurs on the highest part of Ganges floodplain area occupying level ridges and inter ridge depressions. The ridges are above flood level while the inter ridge depressions are shallowly flooded in the monsoon season. This unit is included in land use mapping unit No. 3, double and single cropped land. Low organic matter, low nutrient content and shortage of soil moisture in the months of January - February reduce the yield of rabi crops. Intermittent wetness in the rainy season restricts the cultivation of kharif vegetables. With irrigation the soils can produce high yield of sugarcane, aus, jute, wheat, mustard, vegetable, tobacco and lentil.

Mapping unit No. 8 ; soil unit No. 8, 12, soil unit No. 8 : Sara - Gopalpur, irregular phase, soil unit No. 12; Tahirpur - Teghar, made - land, 1,550 ha;

The area comprises mainly man-made raised platforms. The raised platforms are not flooded by rain or river water, while the land between the platforms are shallowly flooded. this unit is included in land use mapping unit 2, double with some rabi and kharif vegetables and single cropped land. Low organic matter, low nutrient content land shortage of soil moisture in the month of January - February reduce the yield of rabi crops. With small scale irrigation highland soils can produce high yield of aus/jute, vegetables, cotton, mustard and sugarcane. Medium highland soils can produce two transplanted rice crops per year. These soils are marginally suitable for irrigation.

Mapping unit No. 9 ; soil unit No. 4, Nijhuri - Atahar - Nachol, rolling phase, 2,780 ha;

The area comprises a rolling landscape having more or less level summits and terraced slopes. The area is not flooded but rain water is kept in the field by boundary bunds. This unit is included in land use mapping unit No. 5b, predominantly single cropped land. Low organic matter, low nutrient content and shortage of available moisture restrict the cultivation of rabi crops. Rolling topography is an additional limitation. Large scale irrigation is not posssible. These soils are marginally suitable for irrigation according to rolling topography.

TABLE I-4-1 LAND CHARACTERISTICS/QUALITIES (1/2)

Soil mapping unit \ Land qualities	Land type	Slope	Soil texture	Soil depth	Soil drainage	Available moisture	Reaction	Organic matter
1	Highland	Level	Loam/clay loam.	Mod. deep	Imperfect	Low	Mod. acid	Low
2	Highland	Undulating	Loam/clay loam.	Mod. deep	Imperfect	Low	Mod. acid	Low
3	Highland	Slopping	Loam/clay loam.	Mod. deep	Imperfect	Low	Mod. acid	Low
4	Highland	Rolling	Loam/clay loam.	Mod. deep	Imperfect	Low	Mod. acid	Low
5	Highland	Slopping	Loam/clay loam.	Mod. deep	Imperfect	Low	Mod. acid	Low
6	High to Med. highland	Level	Loam/clay	Mod. deep	Imperfect to poor	Low	Mod. acid	Low
7	Highland	Level	Loam	Mod. deep/deep	Imperfect	Medium	Mod. alkaline	Low
8	Highland	Irregular	Loam	Deep	Imperfect	Low	Mod. alkaline	Low
9	High to Med. highland	Slopping	Clay	Deep	Poor	Low	Mod. alkaline	Medium
10	Med. high to Med. lowland	Level	Clay	Deep	Poor	Low	Neutral	Medium
11	Medium low/lowland	Level	Clay	Deep	Poor	Low	Neutral	Medium
12	Highland	Irregular	Loam	Deep	Imperfect	Low	Neutral	Low

TABLE I-4-1 LAND CHARACTERISTICS/QUALITIES (2/2)

Land qualities / Soil mapping unit	Land type	Slope	Soil texture	Soil depth	Soil drainage	Available moisture	Reaction	Organic matter
13	Medium highland	Level	Clay loam/clay	Deep	Poor	Low	Neutral	Low
14	Medium highland	Level	Clay	Deep	Poor	Low	Neutral	Medium
15	Medium lowland	Level	Clay	Deep	Poor	Low	Mod. acid	Medium
16	Lowland	Level	Clay	Deep	Poor	Low	Mod. acid	Medium

TABLE I-4-2 CROP REQUIREMENT (1/3)

Kind of land use	Suitability class	Land type	Slope	Soil tex.	Soil depth	Soil drainage	Available moisture	Soil reaction	Organic matter
Fruit trees/ vegetables	S_1	Highalnd	Level	Loam/ clay loam	Deep	Well/ mod. well	High	Neutral	High
	S_2	Highland	Irr./ undulating	Clay	Mod. deep	Imperfect	Medium	Mod. acid/ alkaline	Medium
	S_3	Medium highland	Rolling	Sandy loam	Shallow	Poor	Low	Highly acid	Low
	N	Medium low/lowland	Hilly	Sand	Very shallow	Very poor	Low	Highly alkaline	Low
Sugarcane	S_1	Highland	Level	Loam/clay	Deep	Well/ mod. well	High	Neutral	High
	S_2	Medium highland	Irr./ undulating	Clay	Mod. deep	Imperfect	Medium	Mod. acid/ alkaline	Medium
	S_3	Medium lowland	Rolling	Sandy loam	Shallow	Poor	Low	Highly acid	Low
	N	Lowland	Hilly	Sand	Very shallow	Very poor	Low	Highly alkaline	Low
Cotton	S_1	Highland	Level	Loam/ clay loam	Deep	Well/ mod. well	High	Neutral	High
	S_2	Medium highland	Irr./ undulating	Clay	Mod. deep	Imperfect	Medium	Mod. acid/ mod. alkaline	Medium
	S_3	Medium highland	Rolling	Sandy loam	Shallow	Poor	Low	Highly acid	Low
	N	Medium low/lowland	Hilly	Sand	Very shallow	Very poor	-	Highly alkaline	-
Potato	S_1	Highland	Level	Loams	Deep	Well/ mod. well	High	Neutral mod. acid	High
	S_2	Medium highland	Irr./ undulating	Sandy loam/ clay loam	Mod. deep	Imperfect	Medium	Mod. alkaline	Medium
	S_3	Medium lowland	Rolling	Clay	Shallow	Poor	Low	Highly acid	Low
	N	Lowland	Hilly	Sand	Very shallow	Very poor	-	Highly alkaline	-

TABLE I-4-2 CROP REQUIREMENT (2/3)

Kind of land use	Suitability class	Land type	Slope	Soil tex.	Soil depth	Soil drainage	Available moisture	Soil reaction	Organic matter
Wheat	S_1	Highalnd	Level	Loam/ clay loam	Deep	Mod. well/ imperfect	High	Neutral	High
	S_2	Medium highland	Irr./ undulating	Clay	Mod. deep	Well	Medium	Mod. acid/ alkaline	Low
	S_3	Medium lowland	Rolling	Sandy loam	Shallow	Poor	Low	Highly acid	Low
	N	Lowland	Hilly	Sand	Very shallow	Very poor	-	Highly alkaline	-
Mustard	S_1	Highland	Level	Loam/ clay loam	Deep	Well to mod. well	High	Neutral	High
	S_2	Medium highland	Irr./ undulating	Sandy loam	Mod. deep	Imperfect	Medium	Mod. alkaline/ mod.acid	Medium
	S_3	Medium lowland	Rolling	Clay	Shallow	Poor	Low	Highly acid	Low
	N	Lowland	Hilly	Sand	Very shallow	Very poor	-	Highly alkaline	-
Jute/B.aus	S_1	High/medium highland	Level	Loam/ clay loam	Deep	Mod. well/ imperfect	High	Neutral	High
	S_2	Medium highland	Irr./ undulating	Sandy loam	Mod. deep	Well	Medium	Mod. acid/ mod. alkaline	Medium
	S_3	Medium lowland	Rolling	Clay	Shallow	Poor	Low	Highly acid	Low
	N	Lowland	Hilly	Sand	Very shallow	Very poor	Low	Highly alkaline	-
T.aus	S_1	Highland	Level	Clay loam/ clay	Deep	Imperfect	High	Neutral	High
	S_2	Medium lowland	Irr./ undulating	Loam	Mod. deep	Poor	Medium	Mod. acid/ alkaline	Medium
	S_3	Medium lowland	Rolling	Sandy loam	Shallow	Mod. well	Low	Highly acid	Low
	N	Lowland	Hilly	Sand	Very shallow	Well	Low	Highly alkaline	Low

TABLE I-4-2 CROP REQUIREMENT (3/3)

Kind of land use	Suitability class	Land type	Slope	Soil tex.	Soil depth	Soil drainage	Available moisture	Soil reaction	Organic matter
T.aman	S_1	Highalnd/ medium highland	Level	Clay loam/ clay	Deep	Imperfect	High	Neutral	High
	S_2	Medium highland	Irr./ undulating	Loam	Mod. deep	Poor	Medium	Mod. acid/ alkaline	Medium
	S_3	Medium lowland	Rolling	Sandy loam	Shallow	Mod. well	Low	Highly acid	Low
	N	Lowland	Hilly	Sand	Very shallow	Well	Low	Highly alkaline	Low
Boro	S_1	High/ medium highland	Level	Clay loam/ clay	Deep	Imperfect	High	Neutral	High
	S_2	Medium lowland	Irr./ undulating	Loam	Mod. deep	Poor	High	Mod. acid/ alkaline	Medium
	S_3	Lowland	Rolling	Sandy loam	Shallow	Very poor	Medium	Highly acid	Low
	N	-	Hilly	Sand	Very shallow	Mod. well/ well	Low	Highly alkaline	Low

TABLE I-4-3 LAND SUITABILITY MAPPING UNIT

Mapping unit	Highly suitable	Moderately suitable	Marginally suitable	Soil mapping unit	Area (ha)
1	T. aus, T. aman Boro	Wheat, sugarcane	Fruit trees, vegetables	1	12,940
2	T. aus, T. aman Boro	Wheat	–	6	4,770
3	Boro	T. aus, T. aman	–	10, 13, 14	2,580
4	Boro	–	–	11, 15	6,210
5	–	T. aus, T. aman, Boro.	Wheat	2, 3, 5	28,440
6	–	Boro	–	9, 16	2,640
7	Aus, jute, wheat potato, mustard	Fruit trees, vegetables, cotton	T. aus, T. aman	7	4,460
8	Fruit trees, vegetables, potato, mustard	Aus, jute, wheat, sugarcane	–	8, 12	1,550
9	–	–	T. aus, T. aman	4	2,780
Total					66,370
Miscellaneous					10,630
grand total					77,000

FIGURE I-4-1. LAND SUITABILITY OF PROJECT AREA
NORTH RAJSHAHI IRRIGATION PROJECT

0 1 2 3 4 5km

N

LEGEND

Mapping unit	Highly suitable	Moderately suitable	Marginally suitable	Component soil unit	Area
1	T.aus, T. aman Boro	Wheat, sugarcane	Fruit trees, vegetables	1	12,940
2	T.aus, T. aman Boro	Wheat	—	6	4,770
3	Boro	T. aus, T. aman.	—	10,13,14	2,580
4	Boro	—	—	11,15	6,210
5	—	T. aus, T. aman, Boro	Wheat	2,3,5	28,440
6	—	Boro	—	9,16	2,640
7	Aus, jute, wheat, potato, mustard	Fruit trees, vegetable, cotton.	T. aus, T. aman.	7	4,460
8	Fruit trees, vegetable, potato, mustard.	Aus, jute, wheat, sugarcane.	—	8,12	1,550
9	—	—	T. aus, T. aman.	4	2,780
Total					66,370
Miscellaneous					10,630
Grand Total					77,000

Convention signs

- Project boundary
- Upazila boundary
- Soil unit boundary
- Wide river
- Narrow river
- Railway with station
- Metalled road
- Katcho road
- Settlements
- Water bodies
- Rivers
- Ponds

TANORE

Kakonhat R.S

SONAGARI

RAJSHAHI

FIGURE I-4-1

5 PRESENT LAND USE

5-1 Land Use in General

Land use is defined as how the land is being utilized. Land is used for agricultural purpose, fishery, forestry, settlements or even the recreational purpose. Land is a dynamic system which utilization will be changed within a very short period, so land use data given should not be taken as granted, rather it is an indicative. In this case only the agriculture land is taken into consideration.

According to the land utilization statistics of 1986, land utilization of the Upazilas in the study area is classified into four categories, namely, net cropped area, current fallow, cultivable waste and not available for cultivation. As shown in the TABLE I-5-1, the cultivable area in the Barind tract corresponds to about 82 percent of the gross area, and in the floodplain it is about 70 percent. Land excepting for cultivation, mainly homesteads, water bodies and roads occupy about 20 to 30 percent in the study area (RSO).

Roughly speaking about the cultivated crops in the project area, rice is the most important crop, both in terms of acreage and crop yield. Aus and both transplanted and broadcast aman are grown, but there is relatively little boro. Jute and sugarcane are the main cash crops. Sugarcane is mainly grown in the southern part of the project area. Mustard, lentils, wheat, barley, potato and khesari predominate in the rabi crops. Kharif and rabi vegetables are cropped in a small scale around the homesteads.

The crops, cropping sequences and intensity of land use are mainly determined by elevation of the land in relation to flooding during the monsoon season and by the drainage and soil moisture regime in the dry season. The project area comprises two different landscapes such as Barind tract and flood plain areas. The crops or cropping patterns differs in different landscapes.

In the Barind tract major cropping pattern is T. aman-fallow with some aus followed by T. aman or T. aman followed by boro, irrespective of land type or soil type. In the floodplain area highland loamy soils are occupied by aus/jute-rabi crops or sugarcane with some aus-T.aman-fallow or rabi crops. Made lands are occupied by mainly aus/jute-rabi crops with some rabi and kharif vegetables and sugarcane. Minor area is occupied by

fruit trees. Medium highland in low ridges and basins are usually occupied by T.aman-fallow or aus-T.aman-fallow with some T.aman-boro or mixed aus and broadcast aman-fallow/khesari. Medium low to lowland basins are usually occupied by B. aman-fallow/khesari or boro-fallow.

5-2 Details of Cropping Pattern

From the description of mapping unit and summerizing of the land use, details of crops and cropping pattern along with area and percentage are given in the paragraph 3-4.

5-3 Land Use Mapping Units

Five land use mapping units and their subunits are recognized in the project area. The land use units are shown along with their acreage and soil mapping units in the TABLE I-5-2. Land use map is shown in the FIGURE I-5-1.

TABLE I-5-1 LAND UTILIZATION STATISTICS IN THE STUDY AREA

Location	Upazila	Net Cropped Area 1 (ha)	Current Fallow 2 (ha)	Cultivable Waste 3 (ha)	Not Available* for Cultivation 4 (ha)	Total Area of Upazila 1+2+3+4 (ha)	Cultivable Area 1+2+3 (ha)	Percentage of Cultivable Area
Baring Tract	Niamat-pur	35,626	1,289	828	7,083	44,826	37,743	90.9
	Tanor	22,810	746	285	5,698 [1]	29,539	23,841	80.7
	Godagari	33,530	2,306	287	8,702 [2]	44,825	36,143	80.6
Floodplain	Paba	17,500	146	461	8,096	26,203	18,107	69.1
	Tatal	109,466	4,487	1,861	29,579	145,393	115,834	

* Not availabel land consists of the homestead, water area and road.

1 Including Ganges River area 200 ha.

2 Including Ganges River area 1,000 ha.

Source : Regional Statistical Office (1985-86) .

TABLE I-5-2 LAND USE MAPPING UNIT, AREA AND COMPONENT SOIL MAPPING UNIT

Land use mapping unit		Area (ha)	Soil unit No.
1. Predominently double cropped land			
1a.	Broadcast aman-khessari/mustard and aus-T. aman with some T. aman-boro.	1,970	10
1b.	Mixed aus and B. aman-with some B. aman-khesari/fallow.	300	9
2. Mainly double with some single cropped land.			
	Aus/jute-rabi crops with some rabi and kharif vegetables and sugarcane.	1,550	8,12
3. Double and single croped land			
	Sugarcane and aus/jute-rabi crops with some aus-T. aman-fallow/rabi crops.	4,460	7
4. Mainly single with some double cropped land			
4a.	Mainly T. aman-fallow with some aus-T. aman-fallow and T. aman-boro.	12,940	1
4b.	Mainly T. aman-fallow with some aus-T. aman-fallow and aus-rabi crops and T. aman-boro.	24,500	2
4c.	Mainly T. aman-fallow with some T. aman-rabi crops.	470	13
5. Predominently single cropped land			
5a.	Predominently T. aman-fallow, locally some T. aman-boro.	6.310	3,6
5b.	Predominently T. aman-fallow	5,320	4,5,14
5c.	Predominently boro-fallow	8,550	11,15,16
	Subtotal	66,370	
Miscellaneous land use	Settlements	8,310	
	Water bodies	1,190	10,630
	Ponds	720	
	Rivers	410	
Total		77,000	

FIGURE I-5-1. LAND USE OF PROJECT AREA
NORTH RAJSHAHI IRRIGATION PROJECT

0 1 2 3 4 5km

N

LEGEND

Mapping unit	Land use mapping unit		Area	Component soil mapping unit
	1. Predominently double cropped land			
	1a. Broadcast aman – khessari / mustard and aus – T. aman with some T. aman – boro		1,970	10
	1b. Mixed aus and B. aman with some B. aman – khessari / fallow		300	9
2	2. Mainly double with some single cropped land			
	Aus/jute – rabi crops with some rabi and kharif vegetables and sugarcane		1,550	8,12
3	3. Double and single cropped land			
	Sugarcane and aus/jute – rabi crops with some aus – T. aman – fallow/ rabi crops.		4,460	7
	4. Mainly single with some double cropped land.			
4a	4a. Mainly T. aman – fallow with some aus – T. aman – fallow and T. aman – boro.		12,940	1
4b	4b. Mainly T. aman – fallow with some aus – T. aman – fallow and aus – rabi crops and T. aman – boro.		24,500	2
4c	4c. Mainly T. aman – fallow with some T. aman – rabi crops.		470	13
	5. Predominently single cropped land			
5a	5a. Predominently T. aman fallow, locally some T. aman – boro.		6,310	3, 6
5b	5b. Predominently T. aman – fallow		5,320	4,5,14
5c	5c. Predominently boro – fallow		8,550	11,15,16
	Miscellaneous landuse	Settlements	8,310	
		Water bodies	1,190	
		Big ponds	720	
		Rivers	410	
	Total		77,000	

Conventional signs

- Project boundary
- Upazila boundary
- Soil unit boundary
- Wide river
- Narrow river
- Railway with station
- Metalled road
- Katcha road
- Settlements
- Water bodies
- Rivers
- Ponds

5-4 Proposed Land Use

Land use may be used for agricultural purpose or it may be used for fishery, forestry, settlements or even recreation purpose. In this paragraph only the agricultural land is taken into consideration. The present and proposed land uses are shown in the TABLE I-6-1.

The proposed land use which is shown by the cropping pattern is based on the land suitability of crops under irrigation. The land suitability is determined comparing with the land characteristics and the requirement of crops.

The Project area is divided into three areas, e.g. (1) micellaneous, (2) non irrigable and (3) irrigable areas.

(1) Micellaneous Area. 10,630ha

Micellaneous area includes settlements, water bodies, ponds and rivers.

(2) Non Irrigable Area, 11,560ha

This area contains three areas, namely area below 45 feet elevation, Ganges river side and Sultanganj areas and highland area.

Two formers of them are highly suitable for boro and they are mainly used for the cropping patterns of T.aman-boro, boro-fallow. The remainder is moderately suitable for T.aus and T.aman and the cropping pattern is mainly T.aman-fallow.

These areas are non irrigable, so some increase of the high crop yield in them should be produced in the present cropping patterns with the application of organic and chemical fertilizers and the improvement of cultural practices.

(3) Irrigable Area, 54,810ha

The area occurs the Barind area and the Paba area.

1) Barind Area, 45,340ha

In the Barind area the cropping patterns are mainly T.aman-fallow with some aus-T.aman or T.aman-boro. The area is highly suitable for T.aus, T.aman and boro or moderately suitable for T.aus, T.aman, wheat and boro. Therefore, the proposed cropping

patterns are decided as T.aman-boro, 60%, Aus-T.aman, 30% and T.aman-wheat, 10%.

2) Paba Area, 9,470ha

The cropping patterns vary according to the flood conditions of areas. Highland soils are occupied by mainly aus/jute-rabi crops or sugarcane. The soils of made lands are occupied by mainly aus/jute-rabi crops. Medium highland in low ridges and basins are usually occupied by T.aman-fallow or aus-T.aman-fallow. Medium low to lowland basins are usually occupied by B.aman-fallow/khesari or boro-fallow.

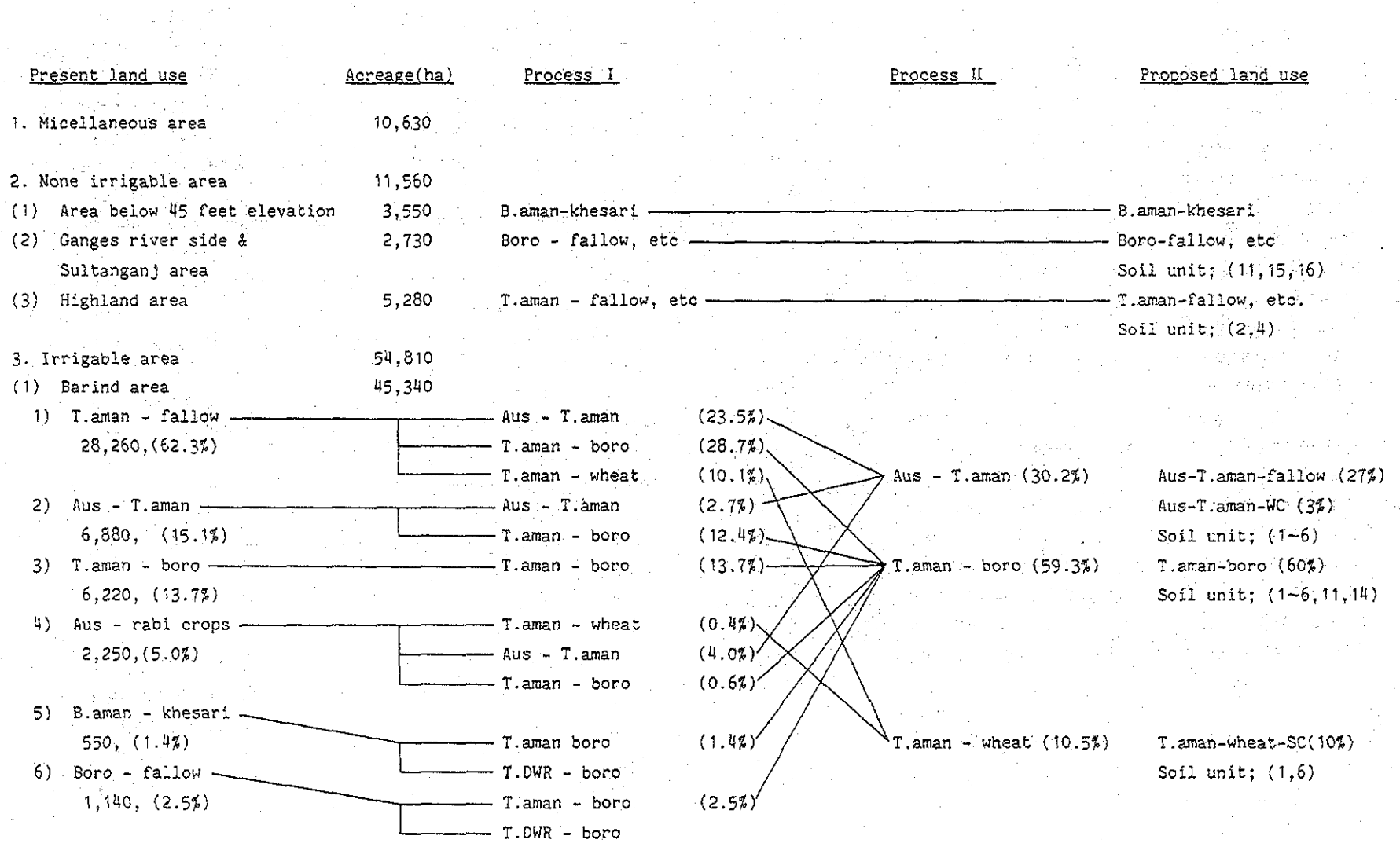
The highland areas, soil unit No.7, 8, 12 are highly suitable for aus, jute, wheat and mustard or fruit trees, vegetable, potato and mustard. Medium highland areas, soil unit No.9, 10, 13, are highly or moderately suitable for boro. The areas of soil unit No.11, which mainly belong to medium lowland are similar to soil unit No.10 in the land suitability.

The proposed cropping patterns are shown in the TABLE I-6-1. Major cropping patterns are sugarcane, 24%, fallow-T.aman-boro, 24%, T.aus-T.aman, 12%, jute-T.aman-WC, 12%, and SC-T.aman-wheat, 12%.

TABLE I-6-1 PRESENT LAND USE AND PROPOSED LAND USE

IN THE PROJECT AREA

Total area; 77,000(ha)



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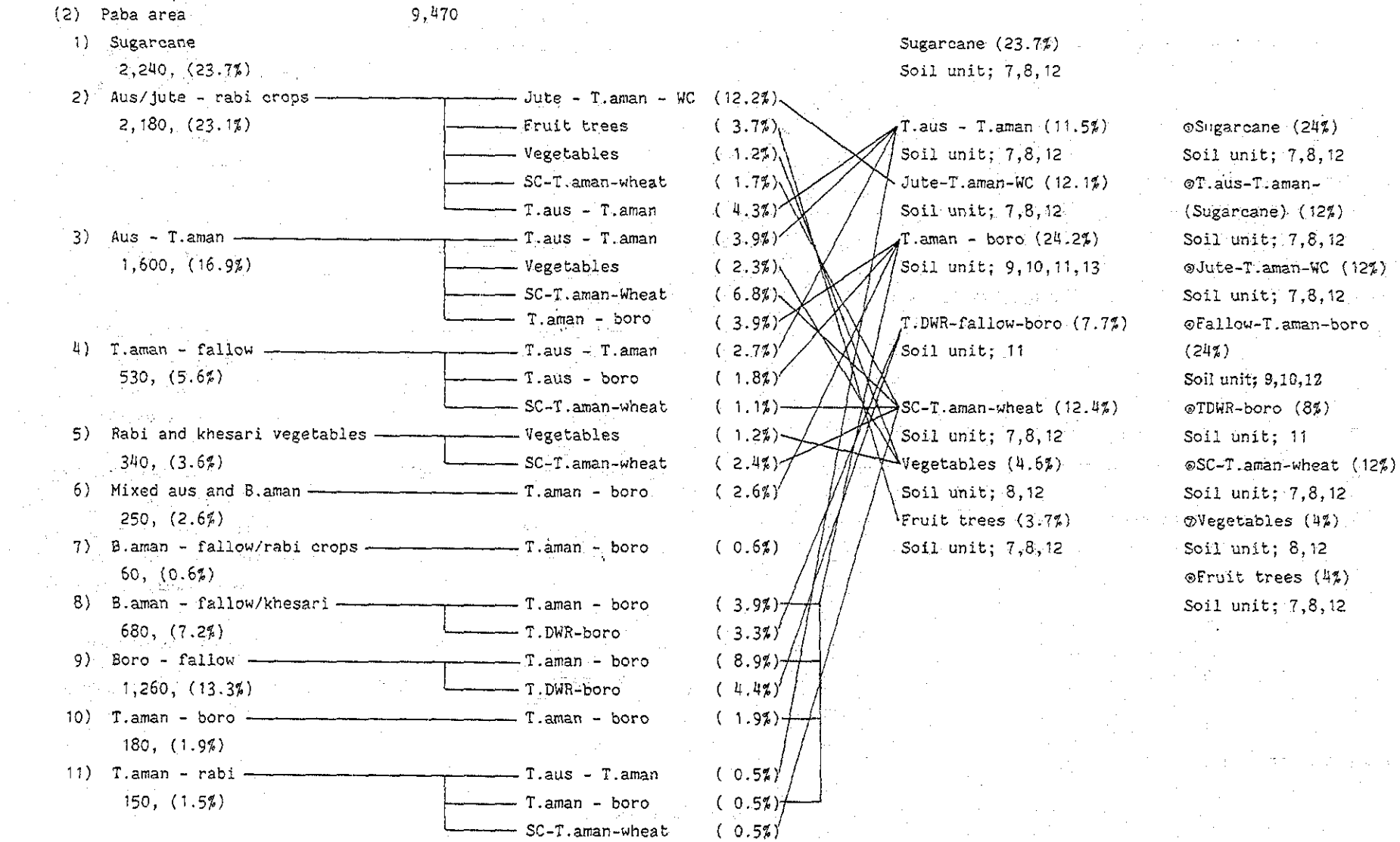
(2) Paba area 9,470



6 SOIL CONDITION FOR CROPS

The field survey are carried out from 27th November to 20th December, 1987. Soils in the project area are supplementally checked by auger digging pits. Soil profile survey for each soil series is done by the standard open pits and soil samples are taken from the open pits for laboratory analysis. Results obtained are as follows as; ① The probable soils which occur in different land type are deduced from the photo interpreted land type, the reconnaissance soil map and report. Further the photo-interpreted soil map of the project area is prepared. ② The soils in the project area are classified into one order Inceptizol, three subgroups Typic Haplaquepts, Aeric Haplaquepts and Aquic Eutrochrepts in the higher categories of classification based on Soil Taxonomy. ③ Twenty one (21) soil series are recoginized in three physiographic units, a. g., (a) seven (7) series in the Barind tract, (b) eleven (11) soil series in the Ganges floodplain and (c) three soil series in the Tista floodplain. ④ Characteristics of individual soil series are described about the profiles and the chemical and physical properties are obtained by the laboratoty analysis. ⑤ Sixteen (16) soil mapping units are classified depending on the consideration of land type. The description of mapping units are arranged to show the distributions and characteristics of soils, land type, present land use, limitations of agricultural use and possibility of improving crop production. ⑥ The data collected during field survay is interpreted for providing the crop suitability rating of individual soil units. Land suitability classification are carried out by the rating of soil suitability for the production of specified crops. Land suitability classification of the project area is done based on the land characterisitics/qualities and crop requiements. Ten crops are taken into consideration and the project area are classified into nine (9) land suitability units.

(1) The results mantioned above should be valid and useful for the irrigation project as well as the improvements of land use and crop production in the project area.

(2) Increase of crop yield should be successful by means of the application of organic and chemical fertilizers and also improvement

of physical and chemical properties of soils through the introduction of green manure in cropping patterns.

1) Application of organi matters.

It is really difficult to apply organic matters in the farmer's field so that green manuring crops should be cultivated in the cropping patterns as follwing.

Boro-T. aman- (Green manure)

Wheat- (Green manure) -T. aman

T. aus-T. aman- (Green manure)

T. aus- (Green manure) -Boro-T. aman-Wheat- (Green manure)

2) Nitrogen, phosphate and potassium contents of the soils are confirmed generally in the low level. Apparently, little or no fertilizers are applied to the soils in the project area. The application of chemical fertilizers, therefore, is very important to produce the desirable yield of rice crops and other upland crops under irrigation. It is necesary to solve the problems mentioned below on the soil management under the irrigation.

(a) Effective application of fertilizers for each crop in the cropping patterns.

(b) Study on relationship of nutrient contents among soil, water and crop.

3) Sulphur content is lower than 10 ppm that is a restricting level for normal growth of crops in most soils of the Barind tract. Low content of sulphur in soils might prossibly reduce the yield of rice or other crops accompaning with no supply of sulphur and low sulphur content of irrigation water.

(a) It is desirable to study the simple trials of sulphur at the farmer's field of representative soils in which sulphur deficiency may easily appear.

(b) It is desirable to establish the deciding method of sulphur deficiency.

4) Zinc contents ranges from 0.22 to 7.13 ppm and the average zinc content is 3.2 ppm in the topsoils of the Project area.

The soils which are less than 2 ppm in zinc content have possibility to appear zinc deficiency in the Project area. Especially, the calcareous soils is necessary taking into the consideration of zinc deficiency due to alkalinity.

APPENDIX II

METEOROLOGY, HYDROLOGY AND RIVER MORPHOLOGY

APPENDIX II

METEOROLOGY, HYDROLOGY AND RIVER MORPHOLOGY

CONTENTS

LIST OF TABLES

1. AVAILABLE DATA

1-1. Meteorological Data

1-1-1. General Climate

Bangladesh has a tropical monsoon climate with a hot and humid summer and a dry cool winter season.

By April or May the south-west monsoon which originates over the Indian Ocean, carries warm and moist air, causing local rainshowers accompanied by thunderstorms and cyclones. The south-west monsoon is preceeded by the relatively moist and warm easterly "trades". This transition period from dry to wet season, sometimes lasting for several months (March to May), is often referred to as the "pre-monsoon" season. The month from June until October is known as the "True monsoon" season. At the beginning of November, the south-west monsoon has withdrawn from Bangladesh, giving way to the north-east monsoon. As it originates over the Siberian ice covered land mass, the north-east monsoon is cold and dry, causing relatively low temperatures during the winter season from November to February with little or no rainfall. The Project Area is located in the driest part of the country, where mean annual rainfall is about 1,400 mm in Rajshahi. About 85 percent of the annual rainfall occurs from June through October. The annual rainfall dispersion is high, in particular at Rajshahi where observed annual rainfall varied from 816 mm to 2,144 mm (period of record 1920-1987).

The Bangladesh Meteorological Department has published long-term meteorological data covering the whole country in March 1985 and entitled "Climatological Data and Chart (1961-1980)". Also general meteorological and hydrological data in the country are shown in the "1986 Statistical Yearbook of Bangladesh" published by Bangladesh Bureau of Statistics.

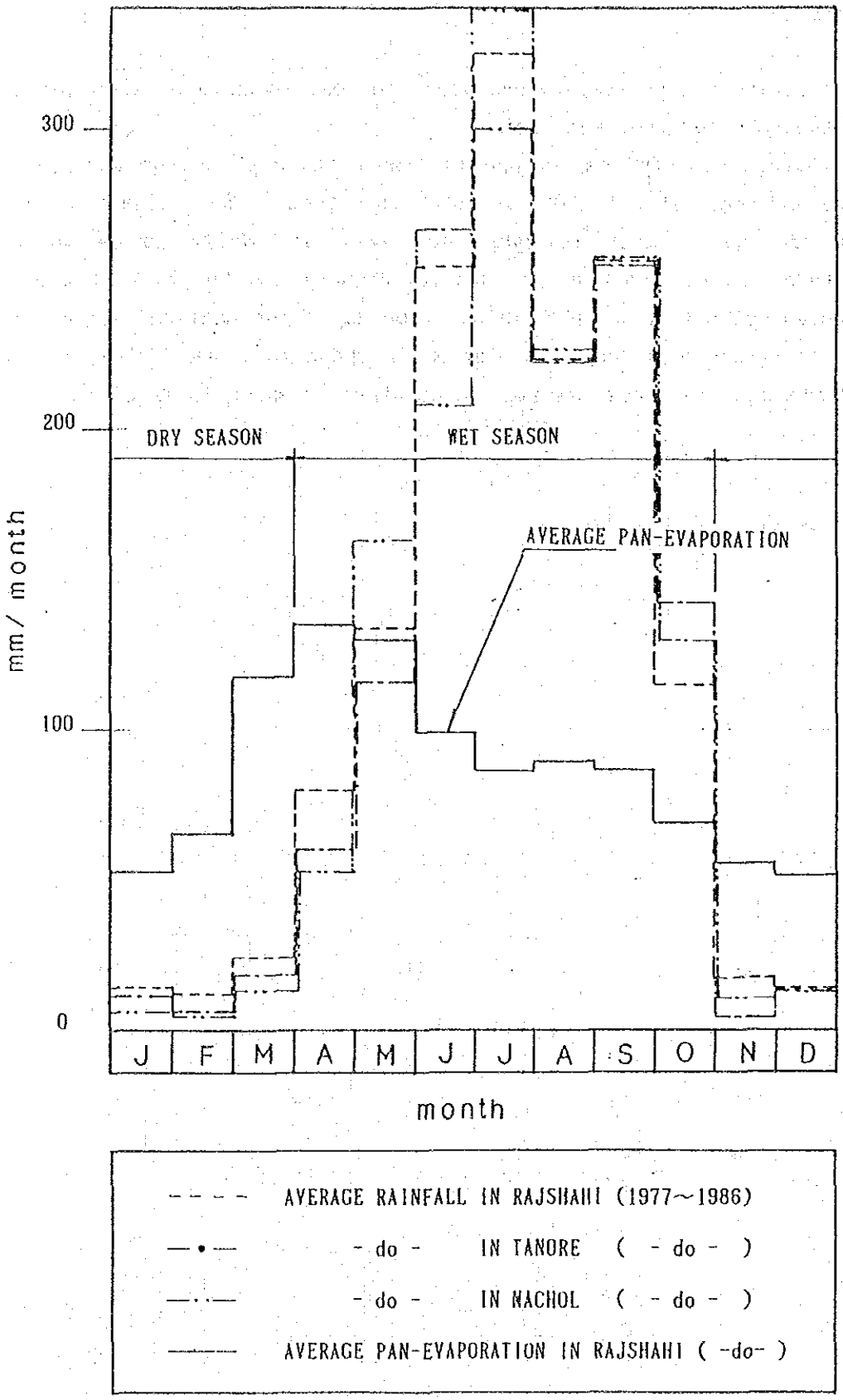
The Rajshahi station has been selected to represent the climate conditions in the Project area. The monthly average temperature, relative humidity, mean daily windspeed, and evaporation data are shown in TABLE II-1-1.

TABLE II-1-1 Climatological data at Rajshahi (mean monthly averages)

	Mean daily Temperatare (℃) (1)	Relative Humidity % (1)	Mean daily Windspeed (m/sec) (1)	Duration of Bright Sunshine (hrs/day) (2)	Pan evaporation (mm)
Jan.	18.4	70	0.9	7.2	53
Feb.	20.5	65	0.9	8.4	67
Mar.	25.8	54	1.0	8.3	118
Apr.	29.5	60	1.5	9.0	135
May	29.3	71	1.6	7.4	130
June	28.9	84	1.4	4.7	99
July	29.1	88	1.4	3.2	87
Aug.	29.5	86	1.3	6.0	90
Sep.	29.3	84	1.3	5.2	87
Oct.	27.4	80	1.0	5.0	81
Nov.	24.5	74	0.9	8.6	69
Dec.	19.9	73	0.9	8.1	56

Source (1) Climatological Data and Charts BMD 1985
(2) Statistical Year book of Bangladesh 1986
(3) Daily and Monthly Evaporation in Bangladesh

FIGURE II-1-1 AVERAGE SPOT RAINFALL, EVAPORATION



(1) Temperature

The distribution of temperature over the year shown that there are two distinct seasons of cool and warm.

The average monthly temperature is almost below 25°C from November to February and about 29°C to 30°C in March to October. The coldest month is January and the warmest is April or May. The daily lowest minimum temperature becomes about 6°C to 8°C in January and the highest maximum one becomes about 42°C to 44°C in April or May. The maximum, minimum and average temperature at Rajshahi Station is shown in TABLE II-1-2, and the highest maximum and lowest minimum temperature is shown in TABLE II-1-2.

TABLE II-1-2 MONTHLY TEMPERATURE AT RAJSHAHI (UNIT °C)

DAILY MAXIMUM

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
64	24.7	28.7	35.1	35.9	34.1	34.0	31.1	31.8	31.8	30.7	28.7	26.2	31.1
65	25.6	28.5	32.0	35.8	34.6	33.8	31.7	31.4	32.0	31.0	28.7	24.5	30.8
66	24.5	30.2	35.6	38.2	37.7	34.1	32.6	31.8	31.3	30.3	28.7	25.5	31.7
67	25.4	29.6	30.3	35.1	36.5	33.9	32.3	31.6	31.6	31.5	28.2	26.2	31.0
68	24.2	27.6	32.7	36.5	38.8	31.2	31.4	32.9	32.5	30.3	28.1	25.2	30.9
69	-	-	-	-	-	-	-	-	-	29.8	28.7	25.5	28.0
70	-	-	-	-	-	-	-	-	-	-	-	-	-
71	24.6	27.6	-	-	-	31.7	31.4	31.5	34.2	32.8	29.8	27.0	30.1
72	25.5	25.7	33.2	37.2	38.9	35.3	32.9	31.6	32.9	32.1	29.5	26.3	31.8
73	26.1	29.6	35.2	38.2	32.8	32.3	32.1	31.6	31.0	30.2	27.9	25.2	31.0
74	24.8	28.7	33.0	35.5	34.8	34.3	31.3	32.3	31.9	32.8	30.1	25.2	31.2
75	25.0	28.1	33.5	37.7	36.1	34.0	30.9	31.7	31.1	31.2	28.4	25.7	31.1
76	25.8	28.2	33.7	36.2	34.4	33.3	32.3	30.9	32.2	32.0	30.7	26.2	31.3
77	24.9	28.9	36.0	35.1	33.0	31.5	31.9	32.6	33.3	30.8	29.0	26.0	31.1
78	24.4	26.9	31.1	32.5	32.9	31.5	31.6	31.6	31.0	31.2	29.3	25.0	29.9
79	25.2	25.5	33.1	35.9	38.8	34.7	32.0	32.7	32.9	32.0	30.7	25.4	31.6
80	24.5	28.0	33.2	39.1	38.5	31.1	31.7	33.1	32.3	31.1	28.5	26.9	31.2
AVERAGE	25.0	28.1	33.4	36.4	35.5	33.1	31.8	31.9	32.1	31.2	29.1	25.8	31.0

DAILY MINIMUM

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
64	10.9	13.6	18.5	23.5	24.3	26.6	25.9	26.6	25.9	24.5	18.2	13.5	21.0
65	12.2	13.4	16.7	22.3	24.9	25.7	25.8	25.8	26.2	23.4	18.6	13.0	20.7
66	11.0	13.1	16.9	25.2	25.3	26.6	26.2	26.2	25.7	22.2	18.6	12.9	20.8
67	11.9	13.8	18.4	21.0	25.2	25.9	26.4	26.1	25.8	22.6	15.6	13.5	20.5
68	11.7	12.1	18.4	23.2	25.4	25.1	26.3	26.3	26.6	22.8	17.7	12.4	20.7
69	-	-	-	-	-	-	-	-	-	24.1	18.3	13.6	18.7
70	-	-	-	-	-	-	-	-	-	-	-	-	-
71	12.4	13.2	-	-	-	26.3	26.0	25.0	25.4	23.3	17.8	13.1	20.3
72	11.7	12.1	18.9	22.8	26.3	26.4	26.7	25.7	25.0	23.2	17.6	13.0	20.9
73	11.3	13.1	17.6	24.8	24.2	25.4	26.3	26.4	25.3	24.0	19.1	13.2	21.0
74	11.8	13.0	18.2	24.2	24.7	26.1	25.5	26.5	25.8	25.2	19.1	11.9	21.0
75	11.7	14.9	18.7	24.1	25.1	26.6	25.7	26.3	25.9	25.3	16.9	12.0	21.1
76	12.1	16.1	19.8	23.3	23.7	25.8	26.3	25.9	25.9	23.7	19.3	12.5	21.2
77	11.3	13.9	20.8	22.5	22.2	24.3	26.8	26.5	25.5	23.2	20.2	14.3	21.4
78	11.4	14.1	16.4	22.3	24.1	25.2	25.9	25.9	25.7	24.0	18.5	13.0	20.5
79	12.9	13.2	17.5	23.2	25.9	26.2	26.1	26.4	25.7	23.7	20.5	14.1	21.3
80	12.3	13.2	18.1	25.0	23.5	26.0	26.4	26.6	26.6	23.2	18.0	14.0	21.1
AVERAGE	11.8	13.5	18.2	23.5	24.6	25.9	26.2	26.2	25.9	23.7	18.4	13.1	20.8

DAILY MEAN

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
64	17.8	21.2	26.8	29.8	29.2	30.4	28.5	29.2	28.9	27.7	23.5	19.9	25.1
65	19.0	21.0	24.4	29.1	29.8	29.8	28.8	28.6	29.1	27.2	23.7	18.8	25.8
66	17.8	21.7	26.2	31.7	31.6	30.4	29.5	29.0	28.5	26.3	23.7	19.2	26.3
67	18.7	21.7	24.4	28.1	30.9	29.9	29.3	28.9	28.8	27.1	22.0	17.9	25.5
68	18.0	19.8	25.6	29.9	32.1	28.2	28.9	29.3	29.6	26.6	22.9	18.8	25.8
69	-	-	-	-	-	-	-	-	-	27.0	23.5	19.5	23.3
70	-	-	-	-	-	-	-	-	-	-	-	-	-
71	18.5	20.4	-	-	-	29.0	28.7	28.2	29.9	28.1	23.8	20.1	25.2
72	18.6	18.9	26.1	30.5	32.6	30.9	29.8	28.7	29.0	27.7	23.6	19.7	26.3
73	18.8	21.4	26.5	31.5	28.6	28.9	29.2	29.1	28.5	27.2	23.6	19.2	26.0
74	18.3	20.9	25.6	29.9	29.8	30.2	28.4	29.4	28.9	29.0	24.6	18.6	26.1
75	18.4	21.5	26.1	30.9	30.6	30.3	28.4	29.0	28.5	28.3	22.7	18.9	26.1
76	19.0	22.2	26.8	29.8	29.1	29.6	29.3	28.4	29.1	27.9	25.0	19.4	26.3
77	18.1	21.4	28.4	28.8	27.6	27.9	29.4	29.8	30.0	27.0	24.7	20.1	26.1
78	17.9	20.5	23.8	27.4	28.5	28.4	28.8	28.8	28.4	27.6	23.9	19.0	25.3
79	19.1	19.4	25.3	29.6	32.4	30.5	29.1	29.6	29.3	27.9	25.7	19.8	25.5
80	18.4	20.6	25.7	32.0	28.5	28.6	29.1	29.9	29.5	27.2	23.8	20.5	26.2
AVERAGE	18.4	20.8	25.8	29.9	30.1	29.5	29.0	29.1	29.1	27.5	23.8	19.3	26.0

HIGHTEST MAXMUM

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
64	30.7	34.5	38.5	42.1	39.7	41.4	32.9	33.4	33.9	33.4	31.4	29.5	35.1
65	28.0	31.7	36.7	41.7	40.3	40.6	33.9	34.3	35.0	33.7	33.5	29.5	34.9
66	26.4	33.9	43.5	42.7	42.9	43.1	35.8	34.7	35.9	32.9	31.2	28.4	35.0
67	31.3	33.9	34.8	39.5	43.4	40.5	34.5	35.9	33.9	34.0	30.5	27.9	35.0
68	27.6	30.5	38.8	40.9	43.3	36.5	33.5	34.5	35.1	33.3	31.7	27.5	34.5
69	-	-	-	-	-	-	-	-	-	33.4	31.3	27.7	30.8
70	-	-	-	-	-	-	-	-	-	-	-	-	-
71	26.6	30.9	-	-	-	34.8	34.8	35.6	35.9	35.9	31.6	28.5	32.8
72	27.9	32.8	37.5	40.9	45.1	41.4	37.4	35.3	37.0	35.9	33.9	30.4	35.2
73	32.5	34.2	41.2	42.3	37.4	36.7	34.8	33.7	33.7	32.8	31.5	26.9	34.9
74	27.8	34.5	37.5	41.2	39.5	37.5	34.0	34.3	35.0	36.0	32.8	27.3	34.8
75	27.3	33.0	38.6	41.0	41.2	38.5	34.6	35.0	34.0	33.4	30.6	27.0	34.3
76	28.0	33.4	37.3	40.6	42.3	36.2	35.7	33.6	34.0	34.5	33.3	29.5	34.9
77	29.0	35.0	38.5	38.8	39.0	36.5	34.5	36.8	35.4	34.8	32.5	29.5	35.0
78	28.5	31.8	35.5	39.8	39.5	35.0	33.0	33.0	33.5	33.2	31.3	27.5	33.5
79	27.4	31.5	39.7	40.7	42.0	43.5	35.8	35.0	35.8	34.9	33.0	27.0	35.5
80	28.7	32.3	38.3	44.4	40.8	38.0	36.0	38.5	34.0	33.3	30.5	28.5	35.3
81	26.8	34.3	34.2	36.3	36.2	36.8	33.1	-	-	-	-	-	34.0
82	-	-	-	-	-	37.5	38.3	33.8	35.4	35.1	32.2	27.0	34.2
83	28.5	32.3	38.6	39.8	38.2	40.7	36.2	34.1	38.7	33.9	31.4	27.3	34.6
84	26.6	29.6	38.7	42.5	40.2	38.1	33.6	35.1	33.8	34.1	30.6	26.6	34.3
85	28.2	31.6	38.9	-	36.0	37.3	33.6	35.0	34.0	34.0	31.4	28.0	33.5
AVERAGE	28.4	32.7	38.2	40.9	40.4	38.5	34.8	34.8	34.7	34.1	31.8	28.3	34.7

LOWEST MINIMUM

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
64	5.9	8.7	12.5	18.4	20.6	22.5	23.9	24.7	21.2	21.4	13.0	8.7	16.8
65	7.8	10.3	11.7	16.5	21.2	22.5	24.4	24.0	23.7	21.4	15.0	9.4	17.3
66	6.5	9.4	10.3	19.2	19.4	23.3	23.9	24.0	22.5	19.3	14.2	7.3	16.6
67	8.2	8.8	13.6	15.3	20.2	21.6	24.8	25.1	23.2	18.2	12.9	9.8	15.8
68	7.7	6.9	14.5	14.8	16.9	21.2	24.4	23.6	14.4	18.2	14.2	7.1	15.3
69	-	-	-	-	-	-	-	-	-	21.1	12.8	10.7	14.9
70	-	-	-	-	-	-	-	-	-	-	-	-	-
71	8.8	8.6	-	-	-	22.3	24.6	24.4	24.3	16.5	13.9	10.6	17.1
72	8.3	8.4	11.8	19.2	21.3	22.9	23.7	23.6	18.4	19.8	8.2	9.5	16.3
73	8.6	9.9	12.8	20.2	21.7	22.5	24.5	23.9	23.1	19.9	15.6	9.5	17.7
74	7.8	7.3	15.8	19.5	19.5	21.4	23.7	23.9	23.7	19.5	15.0	10.6	17.3
75	8.9	10.0	15.5	18.4	19.5	21.2	23.4	24.5	23.9	22.8	11.8	9.6	17.3
76	9.3	12.3	12.8	20.0	18.9	21.9	25.0	22.8	23.4	20.0	13.9	10.0	17.5
77	8.4	8.9	15.6	19.2	16.2	19.8	24.5	24.3	23.8	20.6	16.2	12.3	17.5
78	8.4	9.8	10.3	18.3	19.8	21.9	24.4	24.4	23.3	20.7	11.9	10.4	17.0
79	10.0	10.3	11.3	18.7	16.4	22.3	24.3	23.4	16.3	21.4	17.0	8.4	16.7
80	8.8	6.9	11.4	20.4	19.4	22.8	24.4	23.5	24.4	20.8	14.4	10.0	17.3
81	9.0	10.6	12.2	17.2	19.8	19.3	23.1	-	-	17.9	12.1	8.3	15.0
82	7.8	-	12.8	18.6	-	23.0	23.3	23.9	22.8	18.5	9.1	8.8	16.9
83	6.3	6.0	11.4	16.4	20.8	22.3	24.0	23.5	24.4	18.8	14.4	7.2	16.3
84	7.1	7.9	9.5	18.2	19.4	23.5	24.0	23.6	22.0	19.3	14.5	8.0	16.4
85	8.8	8.5	13.2	-	19.3	22.4	23.6	23.5	23.5	17.8	11.5	8.0	16.4
AVERAGE	8.1	8.9	12.6	18.3	19.5	22.0	24.1	23.9	22.2	19.7	13.4	9.2	16.8

(2) Relative Humidity

The annual average relative humidity is about 75% and the dryest month is March or April with about 55% and the highest is about 85% to 87% in July or August. The monthly relative humidity at Rajshahi is shown in TABLE II-1-3.

(3) Wind

The prevailing wind direction is southeastern from April to September and northerern to northwestern from October to March. The prevailing wind speed varies about 2.0 m/sec to 4.5 m/sec. The windspeeds in this area of the country are generally much lower than in the coastal belt (TABLE II-1-4).

(4) Evaporation

As shown in TABLE II-1-6, evaporation is maximum in the month of April when both temperature and duration of sunshine are relatively high and relative humidity still low. The sudden increase in cloudiness and relative humidity at the onset of the monsoon causes the evaporation to drop in the month of June.

(5) Sunshine Hour

The sunshine hour records are available from February 1982 as shown in TABLE II-1-5. The longest sunshine hour appears in March and the shortest is in July.

TABLE II-1-3 MONTHLY RELATIVE HUMIDITY AT RAJSHAHI UNIT: %

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
64	72.0	69.0	54.0	68.0	77.0	82.0	88.0	84.0	85.0	85.0	77.0	74.0	76.3
65	71.0	66.0	60.0	64.0	70.0	81.0	87.0	87.0	85.0	80.0	79.0	73.0	75.3
66	77.0	66.0	48.0	55.0	62.0	79.0	85.0	87.0	84.0	81.0	77.0	83.0	73.7
67	75.0	67.0	68.0	52.0	65.0	78.0	86.0	87.0	86.0	79.0	76.0	78.0	74.8
68	76.0	65.0	58.0	55.0	56.0	82.0	88.0	86.0	87.0	83.0	80.0	80.0	74.7
69	-	-	-	-	-	-	-	-	-	74.0	72.0	70.0	72.0
70	-	-	-	-	-	-	-	-	-	-	-	-	-
71	68.0	59.0	-	-	-	85.0	86.0	87.0	80.0	80.0	76.0	76.0	77.4
72	75.0	68.0	57.0	57.0	61.0	74.0	83.0	86.0	82.0	75.0	73.0	68.0	71.6
73	68.0	62.0	56.0	56.0	79.0	87.0	84.0	84.0	88.0	81.0	79.0	76.0	75.0
74	68.0	54.0	55.0	67.0	71.0	78.0	88.0	83.0	82.0	78.0	71.0	67.0	71.8
75	69.0	59.0	50.0	55.0	68.0	75.0	86.0	83.0	85.0	82.0	71.0	68.0	70.9
76	69.0	59.0	48.0	49.0	73.0	81.0	86.0	86.0	84.0	75.0	70.0	69.0	70.8
77	68.0	62.0	53.0	71.0	81.0	90.0	87.0	84.0	82.0	81.0	78.0	72.0	75.8
78	66.0	64.0	59.0	63.0	78.0	88.0	87.0	87.0	85.0	78.0	73.0	70.0	74.8
79	73.0	69.0	45.0	57.0	51.0	72.0	88.0	85.0	84.0	79.0	75.0	78.0	71.3
80	73.0	65.0	58.0	49.0	75.0	86.0	89.0	86.0	84.0	81.0	71.0	70.0	73.9
AVERAGE	71.2	63.6	54.9	58.4	69.1	81.2	86.5	85.5	84.2	79.5	74.9	73.3	73.8

TABLE II-1-4 MONTHLY AVERAGE WIND SPEED AND DIRECTION

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
64	N	NW	W	SE	S	SE	SE	SE	SE	N	N	N	-
	2.1	2.0	2.1	2.5	3.0	3.0	2.9	3.3	2.4	4.2	2.7	2.9	2.8
65	NW	N	S	SE	SE	SE	SE	SE	SE	E	N	NW	-
	2.2	2.0	2.3	2.3	2.9	2.7	2.8	2.3	0.3	2.7	3.8	0.1	2.2
66	NW	NW	NW	SW	SE	SE	SE	SE	SE	N	NE	NW	-
	2.8	2.5	3.1	2.4	3.4	3.3	2.7	2.4	2.4	3.4	2.4	2.3	2.8
67	N	NW	NW	SE	SE	SE	SE	SE	SE	SE	NE	NW	-
	2.4	3.1	2.7	2.9	2.3	2.7	2.6	2.5	2.4	2.1	2.4	2.4	2.5
68	N	NW	NW	SE	SE	SE	SE	SE	SE	N	N	NW	-
	2.3	2.0	2.4	2.8	4.9	3.5	2.9	3.3	2.5	2.3	2.4	2.3	2.8
69	-	-	-	-	-	-	-	-	-	N	N	NW	-
	-	-	-	-	-	-	-	-	-	2.1	2.2	2.2	2.2
70	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-
71	N	NW	-	-	-	SE	E	SE	S	S	N	N	-
	2.3	2.3	-	-	-	2.7	2.4	2.7	2.3	2.5	2.2	2.1	2.4
72	N	NW	S	S	S	SE	S	SE	SE	NW	NW	NW	-
	2.0	3.1	2.4	2.8	4.4	3.4	2.5	3.4	2.5	2.6	2.2	2.9	2.9
73	NW	NW	NW	SE	SE	S	SE	SE	E	NW	NW	NW	-
	2.7	3.5	3.2	4.4	3.5	2.8	3.2	3.3	3.7	2.5	2.8	2.5	3.2
74	NW	NW	E	SE	SE	SE	SE	SE	SE	SE	NW	N	-
	2.8	3.1	3.1	2.8	3.3	2.7	2.5	2.2	4.3	2.0	2.0	2.5	2.8
75	NW	NW	W	S	E	SE	S	E	E	S	N	N	-
	2.6	2.7	3.3	4.1	4.1	2.6	2.9	4.1	3.4	2.8	2.1	2.3	3.1
76	N	N	S	SE	SE	SE	SE	SE	SE	N	N	N	-
	2.3	2.0	2.0	2.7	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1
77	W	N	W	S	SE	SE	SE	SE	SE	SE	NE	NW	-
	3.1	2.6	2.3	3.9	3.7	3.1	3.9	4.6	4.9	3.2	3.1	2.6	3.4
78	NW	NW	SW	SE	E	E	SE	SE	SE	N	W	N	-
	3.1	2.9	2.6	5.8	6.7	5.7	6.3	6.3	6.6	4.5	3.7	4.2	4.9
79	N	NW	S	S	S	SE	S	SW	S	S	N	N	-
	3.9	3.0	3.9	4.9	6.0	6.1	5.1	3.2	4.4	4.3	2.7	3.1	4.2
80	N	W	W	S	E	E	SE	S	S	N	N	N	-
	3.1	4.0	5.6	6.7	6.2	5.1	5.6	5.1	3.3	2.5	2.5	2.4	4.3
AVERAGE	2.6	2.7	2.9	3.6	4.0	3.4	3.4	3.4	3.2	2.9	2.6	2.4	3.1

TABLE II-1-5 MONTHLY AVERAGE SUNSHINE HOURS UNIT: HR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
82	-	7.3	8.1	8.3	9.4	4.7	5.5	4.6	6.3	7.7	7.2	7.3	6.9
83	6.8	8.3	9.0	8.0	7.4	7.0	5.3	6.0	4.6	6.6	8.8	6.2	7.0
84	-	-	9.5	8.1	5.8	3.9	3.7	4.7	6.3	-	9.5	8.5	6.7
85	7.2	8.2	8.7	8.8	7.9	4.8	3.2	5.6	-	-	8.6	8.0	7.1
86	7.9	8.7	9.1	-	-	-	-	-	-	-	-	-	8.6
AVERAGE	7.3	8.1	8.9	8.3	7.6	5.1	4.4	5.2	5.7	7.2	8.5	7.5	7.0

TABLE II-1-6 MONTHLY TOTAL EVAPORATION UNIT: mm

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
77	83.4	113.3	231.6	184.9	153.4	122.0	127.6	145.6	130.4	126.0	91.0	82.6	1591.8
78	83.4	108.1	171.0	191.7	162.0	126.3	119.7	142.3	116.0	123.0	92.3	96.4	1532.2
79	83.9	92.4	193.0	219.6	270.7	199.3	139.9	141.7	133.7	124.4	111.1	79.9	1789.6
80	81.1	95.9	159.6	223.7	172.0	124.0	131.3	137.4	126.1	131.4	115.9	80.3	1578.7
81	75.3	92.4	143.9	158.6	165.4	142.1	130.3	135.6	118.6	136.7	110.9	85.9	1495.7
82	81.0	93.9	130.4	177.0	215.1	148.6	136.0	123.4	130.0	122.3	89.3	78.9	1525.9
83	80.1	95.6	-	-	-	-	-	-	-	99.7	104.3	83.6	463.3
84	77.3	90.0	186.3	186.6	179.1	111.6	101.9	103.4	121.7	101.1	88.0	80.0	1427.0
85	70.1	93.4	194.0	-	-	-	-	-	-	-	-	-	357.5
86	-	-	-	162.4	159.0	157.7	109.7	119.6	98.0	104.7	86.4	58.7	1056.2
AVERAGE	79.5	97.2	176.2	188.1	184.6	141.5	124.6	131.1	121.8	118.8	98.8	80.7	1563.0

1-1-2. Rainfall Data

Rainfall data in Bangladesh have been observed since 1902 by the Agricultural Department. From 1960 most of the raingauge stations are being operated under the Hydrology Directorate of the Water Development Board.

23 raingauge stations are located in and around the study area. The location of them is shown in FIGURE II-1-2. The recording conditions of them since 1961 to 1987 are shown in TABLE II-1-7.

Taking into consideration of the locations of the Study area, the following 10 raingauge stations out of 23 stations have been selected for rainfall analysis. The daily records of rainfall for the stations have been collected from 1962 to 1987.

Station No.	Name of Station	Latitude	Longitude	Elevation (m)
R 185	MANDA	24°47.5'	88°42.3'	17.18
R 187	MOHADEVPUR	24°54'	88°44'	18.49
R 190	NACHOL	24°44'	88°25.8'	38.27
R 194	NITHPUR	25°01.7'	88°27'	26.31
R 195	CAPAI NAWABGAJ	24°35.9'	88°16.7'	21.69
R 205	RAJSHAHI	24°22.3'	88°33.7'	17.88
R 208	ROHANPUR	24°49.3'	88°19.6'	27.60
R 212	SARDAH	24°20'	88°43'	18.40
R 219	TANORE	24°36.7'	88°34.6'	17.21
R 172	GODAGARI	24°23'	88°20.6'	21.62

In order to find a long-term trend of rainfall pattern, all of available monthly rainfall data at Rajshahi from 1920/21 to 1986/87 for 67 years period have been collected.

The annual total rainfall from April to March for 67 years are shown in TABLE II-1-8.

(2) Hourly Rainfall Data

An automatic raingauge recording papers are available at Rajshahi station from 1985. Successive rainfalls more than 100 mm have been selected to find the hourly rainfall distribution pattern.

The selected hourly rainfall data is shown in TABLE II-1-9.

TABLE II-1-7 (1)

LIST OF NAMES OF RAINFALL STATIONS CONNECTED TO THE NORTH RAJSHAHI IRRIGATION PROJECT

(A) RAINFALL STATION

SL.NO.	NAME & NO. OF STATIONS		WATER YEAR (APR. ~ MAR.) 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87
1.	R-205	RAJSHAHI	Aug.
2.	R-23	NATORE	Jul.
3.	R-36	SINGRA	
4.	R-158	BHOLAHAT	
5.	R-172	GODAGARI	
6.	R-184	LALPUR	
7.	R-190	NACHOL	
8.	R-194	NITHPUR	
9.	R-195	CHAPAI-NAWABGONJ	
10.	R-204	PUTHIA	
11.	R-208	ROHANPUR	
12.	R-212	SARDAH	
13.	R-216	SHIBGONJ (CHAPAI-NAWABGONJ DIST.)	

TABLE II-1-7 (2)

LIST OF NAMES OF RAINFALL STATIONS CONNECTED TO THE NORTH RAJSHAHI IRRIGATION PROJECT

(A) RAINFALL STATION

SL.NO.	NAME & NO. OF STATIONS	WATER YEAR (APR. ~ MAR.) 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87
(14)	R-219 TANORE	
15.	R-3 AHSANGONJ (ATRAI	
16.	R-152 BADALGACHI	
(17)	R-185 MANDA	
(18)	R-187 MOHADEVPUR	
19.	R-191 NAOGAON	
20.	R-192 NAZIPUR	
21.	R- 22 NANDIGRAM	
22.	R-189 DHUPCHANCHIA	
23.	R-181 PHITLA	

Note: Records of ◯ station has been use for analysis.

(B) EVAPORATION STATION

SL.NO.	NAME & NO. OF STATIONS	WATER YEAR (APR. ~ MAR.) 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87
1.	E-25 Nawabganj	
(2)	E-29 Rajshahi	

TABLE II-1-8 Monthly Areal Rainfal in Rajshahi (mm) (1)

Month / Year	April	May	June	July	August	September	October	November	December	January	February	March	Annual
1920-21	0.3	63.2	179.8	260.1	178.1	228.3	96.5	0	0	50.3	0	39.6	1096
21-22	120.1	91.4	269.5	325.4	356.4	294.1	15.2	0	0	5.6	8.6	0	1486
22-23	8.4	82.8	376.2	387.4	180.8	289.6	39.1	0	0.3	0	24.1	56.4	1415
23-24	11.7	79.8	163.6	232.2	215.1	159.0	130.6	6.9	0	2.0	1.3	0	1002
24-25	83.1	127.5	144.3	257.6	224.3	434.8	61.5	57.7	0	-	-	-	-
25-26	-	-	-	-	-	-	-	-	-	40.6	1.5	50.3	-
26-27	12.7	138.7	227.8	382.8	206.2	327.4	14.5	1.0	14.2	43.4	37.8	22.1	1429
27-28	1.3	72.9	83.6	230.9	105.7	211.1	56.9	0	0	33.3	33.3	0	829
28-29	27.7	206.8	401.6	442.2	447.3	189.2	348.2	0	0.3	36.3	0	44.2	2144
29-30	57.7	152.9	122.9	305.1	182.1	271.3	297.7	0	19.6	7.9	9.7	66.5	1493
30-31	33.5	56.6	251.7	420.1	183.4	65.0	70.9	127.0	0	0	24.9	75.7	1309
31-32	11.7	99.6	270.5	345.2	293.6	319.3	44.2	27.4	6.4	-	-	-	-
32-33	-	-	-	-	-	-	-	-	-	23.9	9.4	0	-
33-34	57.4	216.2	310.9	277.6	550.4	288.0	44.2	0	0	29.2	40.9	0	1815
34-35	10.9	61.2	239.0	74.9	104.9	151.1	112.5	1.0	51.6	4.3	38.8	27.9	876
35.36	6.1	68.1	321.3	252.5	314.7	116.1	14.5	0	0	12.7	10.2	2.5	1119
36-37	4.3	206.2	366.5	353.3	278.9	217.7	95.2	0	0	0	128.3	0	1650
37-38	7.1	142.2	395.0	170.7	311.9	324.4	86.4	5.1	0	11.9	15.2	0	1470
38-39	0	299.2	671.6	220.0	344.4	281.7	35.6	0	0	0	0.5	31.5	1884
39-40	0	75.2	404.6	573.3	411.0	272.3	243.1	0	0	0	29.7	55.4	2065
40-41	7.4	149.1	214.6	103.1	156.0	142.0	29.5	1.3	0	19.8	0	0	823
41-42	98.0	62.2	376.4	475.2	239.3	162.1	330.7	16.8	0	0	21.1	9.1	1791
42-43	97.0	181.9	189.0	245.9	391.4	449.1	199.9	20.1	0	42.8	0	16.5	1833
43-44	103.4	120.6	272.0	342.1	213.1	150.1	158.5	0	0	-	-	-	-
44-45	15.5	63.0	143.5	305.3	323.3	231.4	18.8	0	0	14.7	18.5	5.3	1139
45-46	98.6	140.7	385.3	461.3	259.8	249.4	352.8	0	0	0	15.2	34.3	1997
46-47	199.4	250.7	172.5	-	77.2	255.0	329.7	12.7	-	-	-	115.6	-
47-48	20.6	172.7	229.6	400.8	278.1	458.2	135.6	0	2.5	0	26.7	2.5	1727
48-49	43.2	94.0	287.5	246.1	144.8	129.5	66.8	5.1	0	0	0	63.5	1084
49-50	27.9	411.0	207.0	344.2	72.9	-	25.4	0	0	0	2.5	-	-

Month Year	April	May	June	July	August	September	October	November	December	January	February	March	Annual
50-51	-	67.8	-	188.0	320.0	102.9	77.5	17.8	0	0	0	25.4	-
51-52	0	91.4	160.0	388.6	147.3	33.0	27.9	20.3	0	0	0	21.6	890
52-53	17.8	20.3	271.8	292.1	157.5	94.0	58.4	5.1	0	68.6	0	85.1	1071
53-54	29.7	76.2	132.1	381.0	111.8	331.5	0	0	0	1.3	0	0	1063
54-55	0	105.2	233.7	403.4	109.7	74.2	208.8	0	0	0	0	2.5	1137
55-56	0	80.5	231.6	349.0	274.8	190.2	46.2	39.9	0	10.7	12.4	14.7	1250
56-57	16.5	175.3	291.3	195.1	422.9	274.3	106.7	64.8	10.7	129.3	47.0	6.6	1740
57-58	0	0	239.8	356.6	134.9	123.4	80.2	0	0	0.8	21.1	0	937
58-59	26.2	64.8	48.5	132.8	291.6	101.3	97.0	0	0	18.5	0	35.6	816
59-60	43.2	174.8	258.6	297.2	431.0	155.4	509.8	0	0	-	-	-	-
60-61	-	-	-	-	-	-	-	-	-	-	-	-	-
61-62	-	-	-	-	-	-	-	-	-	-	-	-	-
62-63	12.4	156.3	183.5	273.0	245.4	173.3	48.7	0	0	5.3	0	9.6	1106
63-64	61.3	130.5	266.8	313.6	152.2	129.3	137.8	8.1	0	1.0	1.5	1.0	1102
64-65	155.7	141.8	269.7	402.3	172.0	417.3	230.7	0	0	0	14.2	56.6	2091
65-66	40.4	84.9	240.5	894.9	220.1	152.5	65.8	10.7	1.8	32.0	0	0	1744
66-67	8.4	87.4	262.9	324.3	310.7	315.3	73.6	27.1	1.3	13.2	1.5	40.3	1466
67-68	77.7	67.4	108.1	285.7	181.8	233.4	9.2	0	0.8	6.6	1.0	20.3	992
68-69	14.3	35.3	347.3	306.7	176.8	189.0	117.3	13.2	0.8	3.6	0	34.0	1239
69-70	47.8	133.6	246.4	282.0	537.8	319.2	74.7	66.0	0	23.6	3.0+	10.6	1745+
70-71	11.7	74.0	338.8	459.6	111.2	176.2	234.3	3.0	0	17.5	1.3+	-	1428+
71-72			135.7	352.3	453.0	290.1	111.8	68.1	0	10.2	14.9	0	1436+
72-73	132.4	190.2	180.9	1.0+	295.2+	207.5	32.5	0+	0	14.7	25.4	21.8	1102+
73-74	59.4	176.8	445.6	233.1	148.7	650.7	87.5	3.6	13.7	0	2.5	53.0	1875
74-75	39.6	102.1	145.3	295.2	157.4	179.9	34.0	0	0	10.9	1.3	7.9	974
75-76	29.4	90.1	41.3	322.7	172.5	271.8	73.9	0	0	0	10.4	0.3	1012
76-77	0	220.1	216.6	213.1	306.7	176.4	52.6	0	0	0	26.7	0	1212
77-78	121.1	207.6	509.9	321.0	179.2	97.8	116.2	7.6	33.5	0	39.9	57.6	1691
78-79	90.8	165.2	235.4	265.3	162.8	428.4	169.9	21.6	0	36.9	16.8	3.8	1603
79-80	79.5	15.2	259.1	499.1	411.5	296.4	47.8	48.3	26.7	26.2	0	41.9	1751.6
80-81	0	226.1	395.5	397.3	275.1	297.2	219.5	0	0	32.5	31.2	27.7	1901.9
81-82	227.3	291.3	76.2	405.1	191.3	304.0	0	0	53.6	0	11.7	76.2	1637
82-83	132.3	40.1	232.4	177.8	236.2	37.3	18.8	72.4	1.5	5.1	4.1	1.3	959.0
83-84	24.0	80.2	148.2	193.9	230.6	131.1	348.0	0	20.6	33.2	0	0	1209.8
84-85	5.8	109.2	249.0	485.9	275.3	303.9	128.6	0	0	4.8	13.5	3.3	1579.3
85-86	48.5	184.0	218.8	263.5	257.4	167.2	51.6	0	0	1.5	4.8	2.3	1199.6

TABLE II-1-9 Observed Hourly Rainfall Distribution at Rajshahi

Unit : mm/hr

	1986				1986					1986			
	8 Sept	9 Sept	10 Sept	11 Sept	25 Sept	26 Sept	27 Sept	28 Sept	29 Sept	5 Oct	6 Oct	7 Oct	8 Oct
1	0	0	0	4.4	4.0	0.2	7.7	7.4	0.1	0	23.5	0.2	20.3
2	0	0	0	0.3	0	0.3	7.3	0.7	0.1	0.1	7.0	0.3	6.7
3	0	0.2	0	0	0	2.8	9.5	3.0	15.9	0	0	0	1.9
4	0	33.8	0.1	0	0	0.4	8.5	4.6	4.3	0	0	0	0.3
5	0	3.0	0	0	0	1.0	1.5	0.6	1.4	0	0	0	0
6	1.2	21.2	0	0	0	0.5	9.0	0.2	0	0	5.1	0	0
7	10.6	1.2	0	0	0	0.3	16.4	6.5	2.1	0	0.9	0.1	0
8	2.0	7.0	0	0	0.5	0.3	2.6	1.0	6.7	0	0	0	0
9	0	11.3	0	0	0.1	0.9	1.0	8.0	0.7	0	0	0	0
10	0	1.5	0	0	0	0.6	0	0.9	0.5	0	1.0	0	0
11	0	0	0	0	0	0.4	0	5.1	1.0	0	0	0	0
12	0	0	0	0	0.3	1.1	0	9.5	2.1	0	0	0	0
13	0	0.2	0	0	0.4	2.7	0	19.5	0.1	0	0	0	0
14	0	6.8	0	0	1.0	2.8	0	5.8	0.1	0	0.1	13.7	0
15	0	1.0	0	0	2.5	3.9	0	4.9	0	0	0	0	0
16	0	0	11.0	0	0.4	8.5	0	1.3	0	0	0	0	0
17	0	0.6	12.2	0	1.5	1.5	0	0	0	1.0	0	1.0	0
18	0	0.9	0	0	0.6	3.6	0	0	0	14.2	15.3	1.2	0
19	0.7	0.2	0	0	0.2	2.5	0	0	0	0.1	4.3	0	0
20	0.1	0	0	0.7	0.1	1.1	0	0	0	0	24.7	2.2	0
21	0	0	0	0	0.2	2.6	0	0	0	0.7	7.2	4.4	0
22	0	0	0	0	0.3	9.3	0	0	0	0.2	3.6	1.1	0.5
23	0	0	0	0.8	0.1	6.5	3.0	0.2	0	4.4	0.5	8.8	0
Total	14.6	88.7	23.3	8.2	12.4	64.2	66.5	79.2	35.1	24.6	94.2	33.5	29.9

1-1-3. Evaporation Data

Evaporation is observed by using U.S. Weather Bureau class A pan at Rajshahi Station. The records are available in the "Daily and Monthly Evaporation in Bangladesh (April 1976 to March 1980)" published by Hydrological Survey of Bangladesh BWDB, Dhaka.

The recorded data of the daily evaporation, however, has been shown 70% value of the observed data. Accordingly, the evaporation data have been revised to the actual observed value by dividing the recorded data by 0.7.

The TABLE II-1-6 shows the revised monthly evaporation data.

1-2. Hydrological Data

1-2-1. Water Level and Discharge Record

The following data of water level and discharge are collected in order to study the flow regime of Ganges, Mahanand and Sib river.

No. and Name of Water Level Station		Name of River	Available Data
211	Godagari	Ganges	1977 - 1980
88	Rampur Boalia	-do-	1977 - 1986
89	Sardah	-do-	1977 - 1986
90	Hardinge Bridge	-do-	1977 - 1986
211.5	Chapai Nawabganj	Mahananda	1980 - 1986
145	Mohadevpur	Atrai	1977 - 1986
261	Nawhata	Sib-Baranai	1977 - 1986

No. and Name of Water Discharge Station		Name of River	Available Data
145	Mohadevpur	Atrai	1977 - 1986
211.5	Chapai Nawabganj	Mahananda	1980 - 1986
211	Godagari	-do-	1975 - 1980
90	Hardinge Bridge	Ganges	1977 - 1986
261	Nawhata	Sib-Barnai	

1-3. River Regime

(1) Ganges River

The correlation of daily water level observed at three points. Rampur Boalia Rajshahi (88), Sardah (89), and Hardinge Bridge (90) is relatively high during 10 years from 1977 to 1986 (refer to TABLE II-1-10).

The fluctuation of water level will occur uniformly at each point in each year. The water level recorded at Rajshahi is shown in FIGURE II-1-3. This figure shows that the water level fluctuates coincidentally at each season.

(2) Sib River

The correlation of daily water level observed at Mohadevpur (145) and Nawhata (261) is relatively high, so that drainage analysis can be made by using these data. In addition, it is necessary to collect and evaluate water level data observed at Pearpur (260).

(3) Water Resources

TABLE II-1-11 shows that the minimum discharge occurs in the end of dry season (from the end of March to the beginning to April) in these 10 years.

The minimum discharge was recorded at 683 m^3/sec in April 1985 in the Ganges. In Mahananda river, the minimum discharge, was recorded at 8.3 m^3/sec at Chapai Nawabganj in May 1984.

1-4. Newly Installed Gauges

In order to find the water level at proposed pumping stations, staff gauges have been installed at Sultanganj in the Mahananda river and at Godagari, Baraipara and Kasba in the Ganges river.

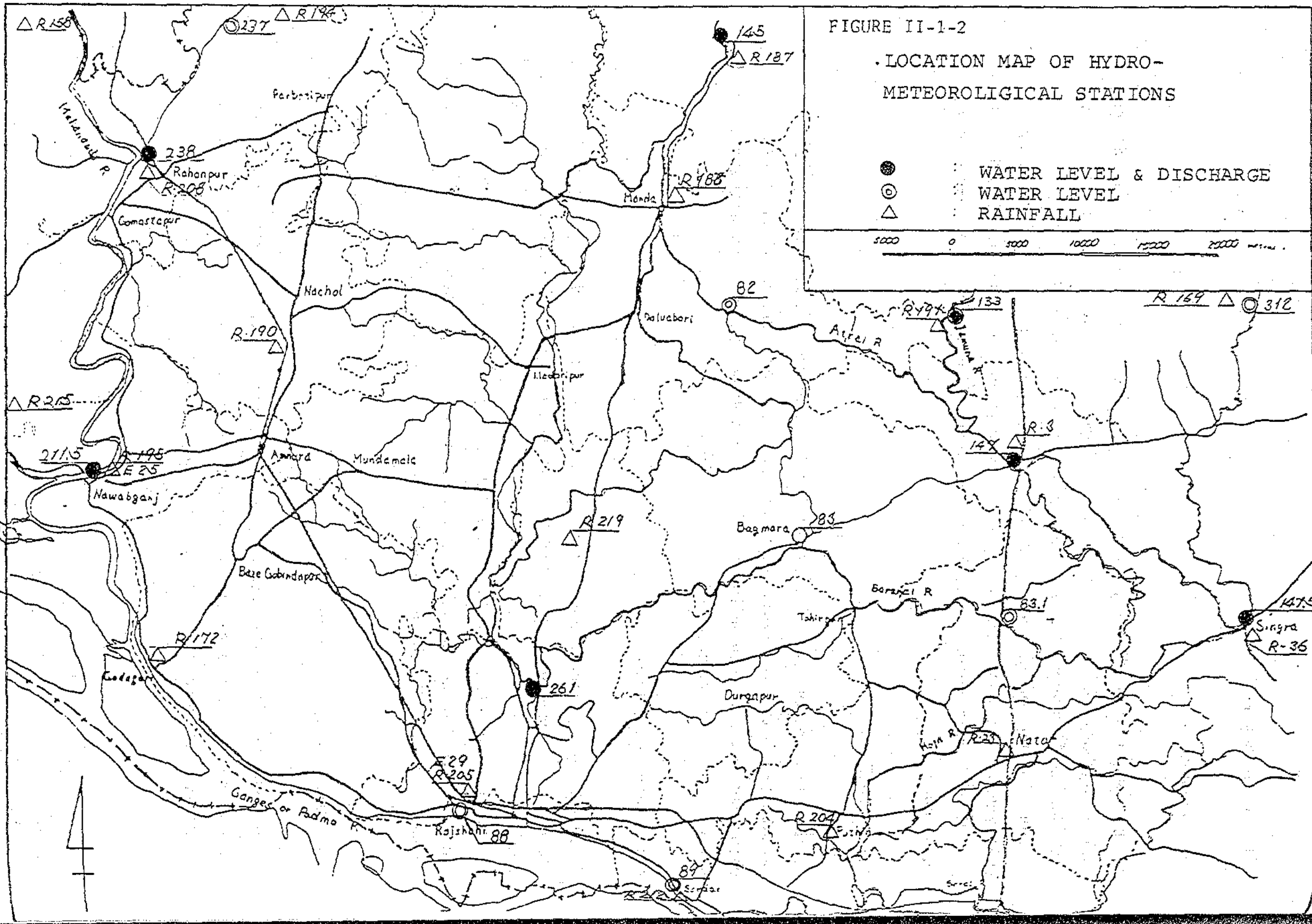


FIGURE II-1-2

LOCATION MAP OF HYDRO-METEOROLIGICAL STATIONS

FIGURE II-1-3 WATER LEVEL HYDROGRAPH OF THE GANGES RIVER AT RAJSHAHI

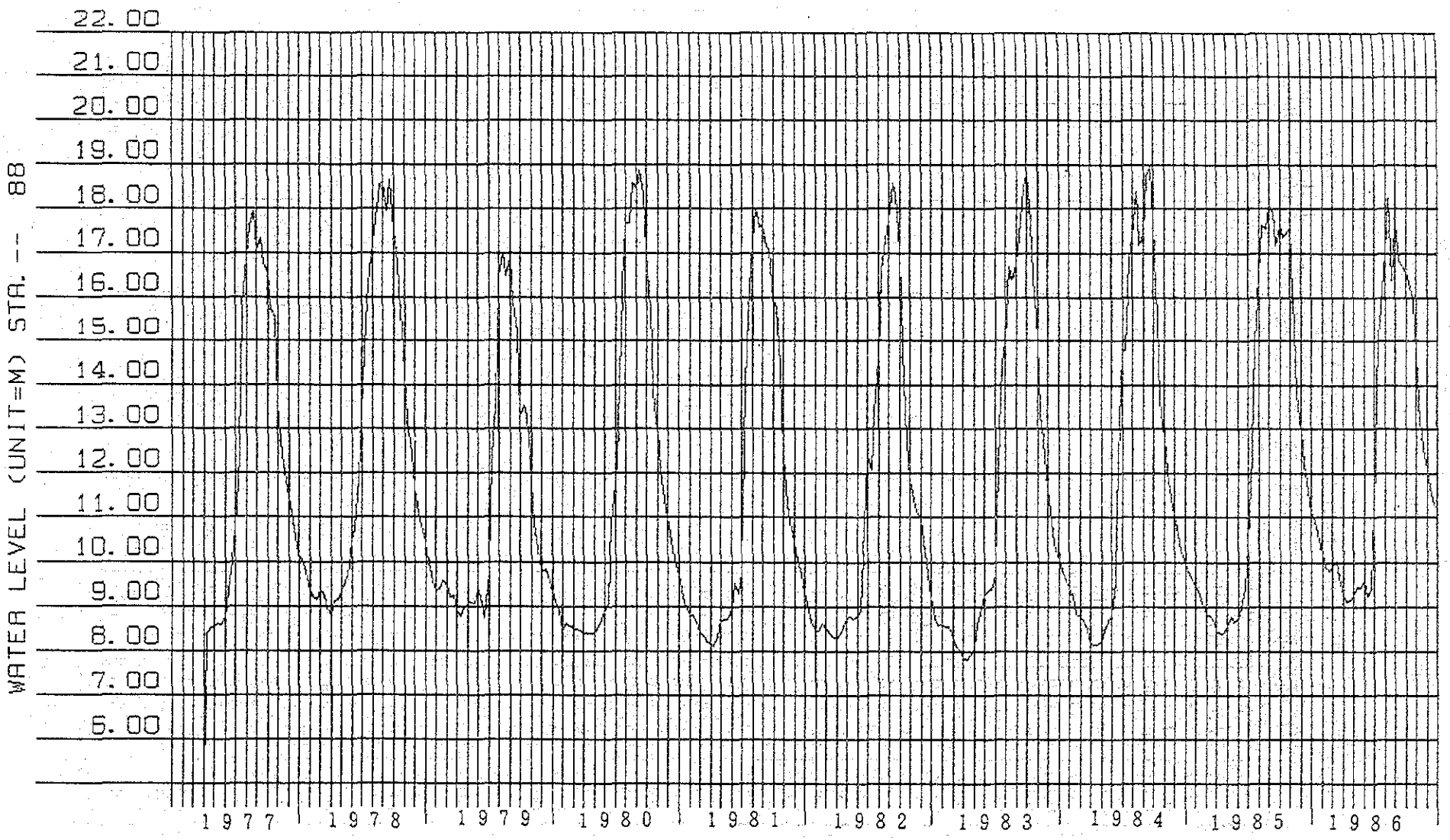


TABLE II-1-10 ANNUAL MAXIMUM AND MINIMUM DISCHARGE IN THE RIVER

Unit : cu.m/sec

Year	Hadinge Bridge		Nawhata		Godagari		Chapai Nawabganj	
	max	min	max	min	max	min	max	min
1937	39,400	1,670						
1938	47,800	1,930						
1939	35,900	1,470						
1940	39,100	1,720						
1941	38,300	1,420						
1942	44,700	1,670						
1943	43,300	1,740						
1944	43,300	2,240						
1945	42,200	1,860						
1946	49,100	1,870						
1947	51,200	1,550						
1948	61,100	1,830						
1949	52,600	2,180						
1950	52,600	1,950						
1951	42,200	1,830						
1952	52,600	1,760						
1953	50,900	1,190						
1954	58,600	1,390						
1955	60,300	1,870						
1956	60,100	2,190						
1957	46,200	2,140						
1958	56,300	2,140						
1959	52,700	2,690						
1960	48,000	1,870						
1961	73,200	1,830						
1962	58,700	2,260						
1963	56,100	2,320						
1964	49,000	2,180						
1965	36,800	2,140						
1966	41,900	1,510			4,810	-		
1967	50,800	1,360			6,820	32.8		
1968	45,200	1,660			4,580	32.5		
1969	55,200	1,690			5,010	32.5		
1970	48,700	2,030			4,580	31.1		
1971	-	-			-	-		
1972	38,200	-			-	-		
1973	50,700	1,930	-	-	3,660	-		
1974	50,700	2,080	162	-	6,060	28.3		
1975	51,100	1,430	42.2	0.324	6,420	35.1		
1976	65,400	657	153	-	12,500	26.6		
1977	51,100	857	170	-	2,620	31.1		
1978	67,900	1,310	75.1	-	3,760	38.5		
1979	36,900	1,040	102	-	2,070	18.9		
1980	57,800	874	90.0	-	-	30.2		
1981	47,900	877	85.2	-	-	-	1,620	-
1982	61,600	1,170	-	-			1,440	8.35
1983	60,000	695	114	-			1,720	8.91
1984	56,500	888	102	-			1,660	23.8
1985	50,600	683	80.2	-			2,150	11.7
1986	-	-	-	-			-	-

TABLE II-1-11 ANNUAL MAXIMUM AND MINIMUM WATER LEVEL IN THE RIVER

Unit : meter in PWD

Year	Hadinge Bridge		Sardha		Rajshahi		Nawhata		Godagari		Chapai Nawabganj	
	max	min	max	min	max	min	max	min	max	min	max	min
1937												
1938	14.815	-										
1939	14.055	7.015										
1940	14.055	6.950										
1941	13.900	6.495										
1942	14.360	7.045										
1943	13.595	7.075										
1944	13.595	7.625										
1945	13.960	7.075										
1946	14.330	6.920										
1947	14.420	6.645										
1948	14.845	6.890										
1949	14.485	7.105										
1950	14.725	6.980										
1951	14.145	6.890										
1952	14.875	7.135										
1953	14.725	7.105										
1954	14.905	7.225										
1955	14.845	6.435										
1956	14.570	7.380										
1957	13.995	7.775			17.624	-						
1958	14.570	7.380			18.258	10.439						
1959	-	-			17.747	0.0						
1960	14.450	-			18.332	10.820						
1961	14.695	-			-	-	12.895	-				
1962	14.480	7.470			-	-	12.715	9.070				
1963	14.390	7.135			18.150	10.940	13.250	9.270				
1964	14.390	7.410			18.165	11.300	13.995	9.760				
1965	13.720	7.395			17.710	10.545	14.315	9.165				
1966	14.280	6.525			17.950	10.535	13.610	8.645				
1967	14.435	6.845			18.320	10.035	12.600	8.765				
1968	14.040	6.935			17.830	10.495	13.845	8.710				
1969	14.675	6.450			18.395	10.295	14.245	8.705				
1970	13.915	6.495			17.920	10.005	13.510	8.725				
1971	-	-			-	-	-	-				
1972	13.400	6.740			17.265	10.180	12.960	-				
1973	14.175	6.435			18.240	9.905	14.400	8.604				
1974	14.385	6.705			18.540	9.420	14.620	8.620				
1975	14.305	6.105			18.455	9.090	12.780		20.460	-		
1976	14.640	5.030			18.740	8.075	14.265		20.855	9.205		
1977	14.110	6.200	17.345	7.130	18.015	8.230	13.960		20.095	9.490		
1978	14.690	6.195	18.000	7.864	18.990	8.755	13.981		21.335	10.135		
1979	13.640	6.081	16.633	7.635	17.743	8.595	14.195		19.657	10.287		
1980	14.859	5.486	18.288	7.590	19.111	7.742	14.432		21.488	10.084		
1981	14.185	6.125	17.343	7.809	17.598	8.047	14.448		-	10.140	20.696	-
1982	14.645	5.860	17.920	7.365	18.860	8.199	13.220				21.310	12.375
1983	14.815	5.375	18.480	7.310	19.230	7.745	14.530				21.709	12.325
1984	14.510	6.020	18.220	7.510	19.150	8.100	14.510				21.740	12.410
1985	14.160	5.670	17.660	7.890	18.610	8.390	14.490				21.020	12.470
1986	14.110	5.970	17.410	7.980	14.590	8.950	14.590				21.100	12.370
1987	-		18.460		19.460	8.900	-				22.24	12.360

TABLE II-1-12 MAXIMUM WATER LEVEL AT RAJSHAHI

711

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
57	-	-	-	10.967	10.622	12.558	17.084	17.227	17.624	15.307	13.143	12.216	14.083
58	12.155	11.140	10.897	10.592	10.866	12.268	16.941	18.258	17.983	17.825	15.234	13.448	13.967
59	12.482	12.344	11.918	10.985	10.826	13.234	16.734	18.440	17.748	17.032	15.240	13.237	14.185
60	12.146	11.628	11.369	11.223	11.643	13.323	17.291	18.364	18.425	17.428	14.929	12.844	14.218
61	12.052	12.098	12.046	-	-	-	-	-	-	-	-	-	12.065
62	-	-	-	-	-	-	-	-	-	-	-	-	-
63	12.040	11.580	11.185	11.035	11.500	14.125	17.040	18.145	18.150	16.755	14.580	13.045	14.098
64	12.430	11.895	11.715	11.455	11.680	13.260	17.250	17.985	18.165	17.695	14.295	12.650	14.206
65	11.765	11.230	10.790	10.760	10.635	12.770	15.455	17.190	17.710	15.895	13.000	11.840	13.253
66	11.185	10.835	10.765	10.765	10.660	11.890	15.605	17.950	17.920	14.720	12.760	12.000	13.088
67	11.315	10.795	10.550	10.475	10.465	11.765	16.640	18.015	18.320	16.535	14.035	12.255	13.429
68	11.895	11.635	11.135	10.855	10.665	14.000	17.610	17.830	17.815	16.775	13.535	12.795	13.862
69	12.080	10.970	10.375	10.425	10.980	12.825	16.825	18.395	18.090	17.290	13.755	12.915	13.744
70	11.665	11.205	11.245	10.735	10.990	14.190	17.170	17.570	17.920	16.775	13.855	12.550	13.823
71	11.485	10.925	10.470	-	-	-	18.485	19.170	18.815	16.980	14.885	12.675	14.877
72	11.545	10.910	10.850	10.455	11.095	12.620	16.030	16.550	17.265	15.880	12.675	11.750	13.135
73	10.860	10.470	10.060	9.995	10.820	15.065	17.730	18.215	18.240	17.325	14.665	12.245	13.808
74	11.130	10.430	9.875	9.715	10.205	12.345	17.335	18.515	18.540	16.115	13.235	11.900	13.278
75	11.605	10.895	9.685	9.570	10.020	13.655	17.830	18.455	18.375	16.580	13.410	11.025	13.425
76	9.840	9.105	8.650	8.260	9.280	12.145	15.390	17.950	18.740	16.195	12.110	10.570	12.353
77	9.510	8.815	8.460	8.620	8.980	11.010	16.945	18.015	17.490	16.475	12.720	11.240	12.357
78	10.060	9.700	9.525	9.420	10.820	14.325	17.310	18.990	18.880	17.435	13.580	11.260	13.442
79	10.195	9.645	9.405	9.144	9.799	10.369	17.236	17.343	16.145	13.868	11.232	10.004	12.032
80	9.226	8.641	8.519	8.428	9.114	12.055	17.831	19.050	19.111	16.459	12.543	10.628	12.634
81	9.418	8.876	8.419	8.784	9.418	10.653	17.745	18.136	17.806	16.282	11.649	10.165	12.279
82	9.053	8.717	8.434	8.785	8.960	12.545	15.478	18.215	18.860	15.887	11.730	10.810	12.290
83	8.825	8.575	8.215	8.145	9.445	10.270	15.920	17.490	19.230	18.130	13.890	11.250	12.449
84	9.940	9.415	8.775	8.330	8.990	15.460	18.170	18.650	19.150	16.520	12.350	10.810	13.052
85	9.830	9.340	8.850	8.690	8.890	10.880	17.470	18.610	18.380	18.610	16.070	12.520	13.118
86	11.080	10.140	10.150	9.360	9.610	12.540	17.700	18.490	17.460	16.790	13.920	11.910	13.263
87	11.400	10.350	9.300	9.400	9.670	11.750	16.700	18.810	19.460	17.080	14.260	-	13.471
AVERAGE	10.973	10.426	10.056	9.835	10.237	12.639	16.998	18.139	18.194	16.643	13.562	11.876	13.323

MINIMUM WATER LEVEL AT RAJSHAHI

712

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
57	-	-	-	10.622	10.470	10.531	12.649	16.575	15.575	13.192	12.238	11.537	12.599
58	11.162	10.796	10.607	10.439	10.455	10.622	12.329	17.154	16.657	15.338	13.497	12.503	12.630
59	12.101	11.933	0.000	10.705	10.683	10.811	13.091	16.718	16.429	15.310	13.283	12.146	11.935
60	11.643	11.323	11.247	10.912	10.820	11.653	13.442	16.383	16.612	15.012	12.570	12.067	12.807
61	11.671	11.595	11.284	-	-	-	-	-	-	-	-	-	11.517
62	-	-	-	-	-	-	-	-	-	-	-	-	-
63	11.550	11.200	10.970	10.940	11.005	11.425	13.910	16.960	16.790	14.600	13.085	12.455	12.908
64	11.910	11.730	11.315	11.300	11.425	11.500	13.470	17.005	17.070	14.355	12.695	11.765	12.962
65	11.245	10.805	10.605	10.560	10.545	10.620	13.165	15.850	15.910	13.060	11.870	11.200	12.120
66	11.835	10.760	10.745	10.630	10.535	10.535	12.165	15.485	14.845	12.810	12.030	11.330	11.975
67	10.750	10.580	10.110	10.035	10.115	10.355	12.900	16.060	16.735	16.035	12.250	11.895	12.318
68	11.665	11.150	10.690	10.545	10.495	10.690	14.185	16.790	14.960	13.585	12.815	12.085	12.488
69	10.970	10.590	10.345	10.295	10.295	11.090	12.780	16.765	16.500	13.785	12.955	11.300	12.306
70	11.145	10.895	10.605	10.455	10.595	10.855	14.080	16.445	16.735	13.915	12.580	11.515	12.435
71	10.925	10.470	10.240	-	-	-	15.980	18.295	16.435	14.975	12.725	11.575	13.513
72	10.920	10.760	10.380	10.265	10.180	11.095	12.435	15.445	15.955	12.725	11.750	10.890	11.900
73	10.300	10.075	9.915	9.905	9.905	10.670	14.265	16.945	17.190	14.830	12.290	11.155	12.287
74	10.455	9.875	9.420	9.580	9.630	9.995	12.290	17.505	15.955	13.165	11.690	10.615	11.681
75	10.090	9.535	9.190	9.205	9.050	9.600	14.120	16.975	16.680	13.535	11.065	9.885	11.578
76	9.035	8.665	8.075	8.075	8.300	9.245	11.895	15.420	16.505	12.205	10.605	9.555	10.632
77	8.850	8.490	8.230	8.350	8.475	9.005	11.060	16.670	15.575	12.800	11.230	10.080	10.735
78	9.280	9.065	8.755	8.960	9.435	10.620	14.765	17.365	17.070	13.685	11.310	10.245	11.713
79	9.235	9.240	8.810	8.748	8.946	8.595	10.759	16.100	12.649	11.284	9.632	9.205	10.267
80	7.742	8.504	8.397	8.367	8.388	8.891	11.765	17.404	16.596	12.634	10.698	9.479	10.739
81	8.717	8.327	8.099	8.047	8.626	9.181	11.415	17.054	15.216	11.741	10.247	9.059	10.477
82	8.382	8.352	8.199	8.325	8.670	8.750	11.870	15.640	16.146	11.775	10.765	8.815	10.474
83	8.515	8.240	7.820	7.745	8.215	9.115	10.140	15.990	17.180	13.940	11.280	9.960	10.678
84	9.290	8.705	8.105	8.100	8.230	8.930	14.560	16.450	16.670	12.420	10.830	9.840	11.011
85	9.340	8.770	8.420	8.390	8.570	8.620	11.020	17.090	16.820	16.210	12.540	10.990	11.398
86	9.980	9.780	9.110	9.080	9.290	8.950	13.390	15.790	15.630	14.090	11.950	11.100	11.512
87	10.360	9.270	9.030	9.000	9.260	8.900	11.390	17.030	17.440	13.250	11.710	-	11.513
AVERAGE	10.313	9.982	9.252	9.556	9.665	10.030	12.803	16.599	16.225	13.664	11.868	10.866	11.755

MEAN WATERLEVEL AT RAJSHAHI

713

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
57	-	-	-	10.809	10.526	11.119	14.835	16.957	16.723	14.025	12.664	11.788	13.272
58	11.393	11.032	10.741	10.497	10.717	10.999	14.390	17.888	17.413	16.735	14.232	12.962	13.250
59	12.209	12.185	0.000	10.827	10.773	12.094	14.855	17.761	17.052	16.373	14.099	12.653	12.573
60	11.865	11.468	11.325	11.048	11.953	12.134	15.452	17.680	17.575	16.406	13.629	12.374	13.576
61	11.846	11.818	11.634	-	-	-	-	-	-	-	-	-	11.166
62	-	-	-	-	-	-	-	-	-	-	-	-	-
63	11.726	11.418	11.108	10.988	11.272	12.734	15.614	17.471	17.621	15.561	13.776	12.703	13.499
64	12.154	11.803	11.498	11.387	11.569	12.075	15.879	17.567	17.720	15.597	13.370	12.141	13.553
65	11.507	11.032	10.652	10.660	10.582	11.571	14.576	16.788	16.779	14.100	12.479	11.484	12.684
66	10.981	10.781	10.759	10.700	10.585	10.835	14.860	17.285	16.490	13.650	12.295	11.680	12.575
67	10.990	10.710	10.270	10.252	10.243	11.237	15.147	17.232	17.952	14.855	13.033	12.037	12.830
68	11.740	11.445	11.004	10.654	10.574	11.956	15.896	17.288	15.824	15.368	13.086	12.416	13.104
69	11.529	10.772	10.434	10.352	10.490	12.083	14.860	17.681	17.022	15.279	13.397	12.215	13.010
70	11.359	11.065	10.789	10.574	10.754	12.144	15.643	17.092	17.321	15.289	13.144	11.987	13.097
71	11.168	10.694	10.366	-	-	-	17.407	19.000	18.192	15.832	13.644	12.057	14.262
72	11.178	10.838	10.639	10.356	10.381	11.480	14.088	15.903	16.620	13.966	12.258	11.362	12.422
73	10.570	10.298	9.986	9.950	10.393	12.768	15.334	17.686	17.760	16.554	13.329	11.625	13.021
74	10.747	10.080	9.620	9.645	9.951	10.779	14.551	18.010	16.969	14.468	12.316	11.399	12.378
75	10.845	10.180	9.410	9.357	9.545	10.779	16.448	17.701	17.551	15.253	12.164	10.370	12.467
76	9.331	8.961	8.334	8.172	8.957	10.869	14.379	16.867	17.565	13.905	11.321	10.125	11.566
77	9.095	8.604	8.330	8.483	8.658	10.042	15.094	17.515	16.877	14.903	11.960	10.569	11.678
78	9.677	9.223	8.989	9.165	9.922	11.975	16.350	18.327	18.029	15.541	12.424	10.752	12.531
79	9.619	9.474	9.108	8.933	9.194	9.188	14.218	16.789	14.788	12.846	10.288	9.593	11.170
80	8.813	8.568	8.449	8.399	8.722	10.576	15.711	18.256	18.086	14.144	11.486	10.022	11.769
81	8.994	8.631	8.244	8.373	8.798	9.530	15.690	17.726	16.712	14.133	10.884	9.667	11.449
82	8.676	8.533	8.346	8.561	8.765	10.691	13.391	17.232	17.983	13.071	11.171	9.786	11.351
83	8.644	8.478	8.000	7.935	8.961	9.485	13.925	16.622	18.248	16.345	12.466	10.436	11.629
84	9.604	8.933	8.453	8.183	8.668	12.227	16.371	17.658	18.471	13.939	11.513	10.253	12.023
85	9.613	9.084	8.646	8.461	8.722	9.587	14.727	17.761	17.571	17.477	14.001	11.637	12.274
86	10.576	9.877	9.638	9.180	9.490	9.950	16.000	17.460	16.710	15.090	12.630	11.410	12.334
87	10.460	9.900	9.760	9.200	9.430	10.200	14.100	17.830	18.580	14.780	12.660	-	12.446
AVERAGE	10.583	10.203	9.467	9.682	9.950	11.111	15.165	17.484	17.317	15.017	12.611	11.339	12.517

TABLE II-1-13 MAXIMUM WATER LEVEL AT GODAGARI

731

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
77	-	-	-	9.815	10.255	12.345	19.020	20.205	19.820	18.815	14.735	12.540	15.293
78	11.425	10.980	10.815	10.540	11.910	15.975	19.390	21.335	21.200	19.725	15.460	13.190	15.162
79	12.070	11.490	11.205	10.933	11.556	12.000	19.433	19.657	18.120	15.636	12.945	11.787	13.903
80	11.156	10.552	10.363	10.226	10.714	13.686	20.108	21.464	21.488	18.547	14.682	12.549	14.628
81	11.354	10.836	10.485	10.826	11.010	-	-	-	-	-	-	-	10.902
AVERAGE	11.501	10.965	10.717	10.468	11.089	13.502	19.488	20.688	20.157	18.181	14.456	12.517	14.329

MINIMUM WATER LEVEL AT GODAGARI

732

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
77	-	-	-	9.555	9.705	10.270	12.390	18.875	17.900	14.875	12.580	11.440	13.066
78	10.635	10.450	10.135	10.225	10.570	11.710	16.415	19.415	19.445	15.595	13.230	12.105	13.333
79	11.050	11.025	10.590	10.461	10.705	10.287	12.497	18.212	14.387	13.045	11.430	11.055	12.062
80	10.677	10.333	10.150	10.084	10.135	10.622	13.503	19.675	18.395	14.576	12.603	11.430	12.682
81	10.735	10.409	10.217	10.413	10.773	-	-	-	-	-	-	-	10.509
AVERAGE	10.774	10.554	10.273	10.148	10.378	10.722	13.701	19.059	17.532	14.523	12.461	11.508	12.541

MEAN WATER LEVEL AT GODAGARI

733

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
77	-	-	-	9.685	9.937	11.269	16.879	19.732	19.190	17.085	13.564	11.915	14.362
78	11.032	10.572	10.343	10.404	11.017	13.245	18.225	20.623	20.347	17.634	14.306	12.649	14.200
79	11.420	11.298	10.904	10.694	10.956	10.836	16.207	18.962	16.626	14.622	12.059	11.406	12.999
80	10.804	10.425	10.244	10.145	10.466	12.235	17.790	20.618	20.357	16.110	13.520	11.925	13.720
81	10.975	10.648	10.327	10.140	10.653	-	-	-	-	-	-	-	10.549
AVERAGE	11.058	10.736	10.455	10.214	10.606	11.896	17.275	19.984	19.130	16.363	13.362	11.974	13.461

TABLE II-1-14 MAXIMUM WATER LEVEL AT CHAPAI NAWABGANJ

741

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
81	-	-	-	13.396	13.981	14.737	20.291	20.696	20.528	18.288	13.945	13.061	16.547
82	12.893	12.725	12.619	12.495	12.565	14.955	17.694	20.390	21.310	18.457	14.467	13.565	15.345
83	13.150	13.017	12.892	12.494	12.995	13.139	18.112	19.557	21.709	20.764	16.335	13.940	15.675
84	13.355	13.134	12.965	12.700	13.520	17.780	20.570	21.020	21.740	19.630	14.800	13.500	16.226
85	13.220	13.070	12.890	12.570	13.150	13.750	19.920	20.950	20.830	21.020	18.990	14.600	16.247
86	13.440	13.070	12.860	12.540	13.350	14.680	20.130	21.100	20.420	19.450	16.300	13.870	15.934
87	13.420	13.020	12.830	12.610	13.060	14.200	19.430	21.920	22.240	20.560	16.860	-	16.377
AVERAGE	13.246	13.006	12.843	12.686	13.232	14.749	19.450	20.805	21.254	19.738	15.957	13.756	16.028

MINIMUM W.L. AT CHAPAI NAWABGANJ

742

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
81	-	-	-	12.863	12.710	12.863	13.350	19.507	17.678	14.006	13.076	12.802	14.317
82	12.680	12.527	12.421	12.375	12.405	12.527	14.514	17.665	18.690	14.455	13.570	13.157	13.916
83	13.002	12.852	12.502	12.325	12.347	12.701	13.317	18.073	19.415	16.493	13.990	13.296	14.193
84	13.148	12.976	12.700	12.430	12.410	13.560	16.820	18.720	19.730	14.850	13.510	13.230	14.507
85	13.070	12.900	12.580	12.470	12.570	12.980	13.930	19.430	19.610	18.590	14.640	13.450	14.685
86	13.070	12.810	12.510	12.370	12.590	12.590	15.660	18.520	18.770	16.500	13.900	13.400	14.391
87	13.030	12.850	12.480	12.370	12.550	12.570	14.300	19.850	20.870	16.100	13.890	-	14.624
AVERAGE	13.000	12.819	12.532	12.458	12.512	12.827	14.556	18.824	19.252	15.856	13.797	13.223	14.375

MEAN W.L.CHAPAI NAWABGANJ

743

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
81	-	-	-	13.052	13.034	13.442	18.075	20.260	19.423	16.273	13.427	12.962	15.550
82	12.784	12.624	12.517	12.422	12.450	13.653	15.859	19.340	20.485	15.707	13.959	13.319	14.593
83	13.073	14.949	12.696	12.391	12.694	12.818	16.346	18.733	20.533	18.919	14.874	13.512	15.127
84	13.249	13.042	12.810	12.536	12.841	15.657	18.627	19.982	21.054	16.851	14.011	13.322	15.332
85	13.152	12.994	12.710	12.509	12.803	13.300	17.083	20.147	20.130	19.933	16.442	13.881	15.424
86	13.227	12.955	12.701	12.460	13.020	12.900	18.230	20.020	19.480	18.280	14.780	13.540	15.133
87	13.180	12.940	12.650	12.400	12.750	13.240	17.140	21.130	21.560	12.830	14.990	-	14.983
AVERAGE	13.111	13.251	12.681	12.537	12.799	13.573	17.337	19.945	20.381	16.970	14.640	13.423	15.151

TABLE II-1-15 MAXIMUM WATER LEVEL AT NAWHATA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
61	-	-	-	9.825	10.330	11.065	11.435	12.680	12.895	12.805	12.510	11.470	11.668
62	10.375	9.765	9.375	9.155	9.460	9.885	11.885	12.650	12.715	12.500	11.580	10.610	10.830
63	10.065	10.095	10.005	9.470	9.500	10.485	12.595	12.910	13.035	13.250	13.220	12.315	11.412
64	11.140	10.630	10.475	10.520	10.165	11.085	13.760	13.995	13.600	13.415	13.140	12.025	11.996
65	10.760	10.020	9.805	9.760	9.485	10.580	14.315	14.210	14.195	13.265	12.060	10.865	11.612
66	9.470	9.130	8.950	8.845	9.105	9.880	11.525	12.895	13.610	13.245	12.410	11.115	10.848
67	9.315	8.995	9.220	9.085	9.025	10.775	12.440	12.545	12.585	12.600	11.945	10.510	10.753
68	9.475	9.200	9.080	8.940	9.355	12.610	13.690	13.845	13.095	13.285	12.670	11.195	11.369
69	9.445	9.185	9.110	9.095	9.585	11.055	12.875	14.210	14.245	14.215	13.270	12.335	11.552
70	11.375	10.590	9.440	8.965	9.315	10.475	13.150	13.510	13.200	13.185	12.540	11.160	11.409
71	9.185	9.050	-	-	-	-	-	-	-	-	-	-	9.118
72	-	-	-	8.740	9.075	10.295	11.085	12.625	12.960	12.470	11.375	9.675	10.922
73	9.180	9.125	8.925	8.660	10.160	13.375	13.590	13.380	14.400	14.140	12.850	11.485	11.606
74	9.300	9.090	9.345	9.000	10.690	10.625	13.490	14.620	13.960	13.940	12.860	11.215	11.511
75	9.920	9.320	9.265	8.815	9.745	10.895	12.780	12.740	12.420	12.445	11.680	9.275	10.775
76	9.930	10.225	10.190	9.745	11.040	10.285	12.590	14.265	13.815	13.360	12.070	9.355	11.406
77	9.845	10.010	9.995	9.678	11.156	13.558	13.960	13.930	13.503	13.137	12.643	11.391	11.901
78	9.418	9.556	9.534	9.876	10.379	13.533	13.366	13.600	13.960	13.981	13.046	11.726	11.831
79	9.958	9.495	9.434	8.825	8.710	9.530	13.440	14.195	13.960	14.050	13.135	11.940	11.389
80	9.295	9.145	9.115	8.672	10.714	12.725	13.487	14.097	14.195	14.432	13.960	12.716	11.879
81	11.101	10.180	9.647	11.003	12.238	13.045	14.127	13.975	14.448	13.716	12.497	9.839	12.151
82	9.382	9.540	9.266	8.810	8.990	11.400	12.400	13.220	13.040	12.810	11.160	10.190	10.901
83	10.780	9.750	9.280	9.220	9.930	10.240	12.100	12.720	13.800	14.530	13.850	12.840	11.587
84	11.290	9.350	9.380	9.760	10.030	12.790	13.980	14.110	14.510	14.370	13.520	11.940	12.086
85	10.260	10.220	9.880	9.720	10.460	11.540	14.040	14.200	14.490	14.450	13.780	12.540	12.132
86	10.050	10.060	9.820	9.710	10.420	9.860	12.780	13.140	14.740	15.500	14.430	13.360	11.989
87	11.720	9.720	9.410	9.780	9.950	10.290	14.450	15.350	15.090	14.270	-	-	12.003
AVERAGE	10.105	9.658	9.498	9.372	9.962	11.226	13.051	13.601	13.710	13.591	12.728	11.324	11.506

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MINIMUM W L. AT NAWHATA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
61	-	-	-	9.270	9.375	10.275	10.800	11.305	12.680	12.470	11.520	10.390	10.898
62	9.800	9.385	9.160	9.070	9.080	9.490	10.055	11.890	12.530	11.610	10.645	10.035	10.229
63	9.990	9.940	9.485	9.270	9.270	9.440	10.505	12.610	12.730	12.760	12.345	11.175	10.793
64	10.645	10.475	10.045	9.880	9.880	9.760	11.190	13.515	13.290	13.140	12.055	10.795	11.223
65	10.035	9.815	9.700	9.365	9.165	9.465	12.790	13.565	13.295	12.075	10.550	9.180	10.750
66	9.120	8.950	8.770	8.675	8.645	9.030	10.260	11.370	12.940	12.455	11.160	9.345	10.060
67	9.010	8.870	8.795	8.765	8.810	8.885	10.790	12.315	12.110	11.960	10.605	9.430	10.029
68	9.200	9.080	8.895	8.725	8.710	9.140	12.630	13.125	12.310	12.430	11.245	9.445	10.411
69	9.195	9.020	8.890	8.705	8.850	9.810	11.045	12.790	13.665	13.295	12.365	11.420	10.754
70	10.605	9.445	8.925	8.725	8.835	8.925	10.435	13.210	12.875	12.570	11.220	9.185	10.413
71	8.995	8.820	-	-	-	-	-	-	-	-	-	-	8.908
72	-	-	-	8.645	8.630	9.030	9.660	11.200	12.365	11.420	9.715	9.185	9.983
73	9.095	8.880	8.645	8.604	8.730	9.765	12.785	12.885	12.410	12.880	11.530	9.330	10.462
74	9.090	8.920	8.665	8.620	8.635	9.745	10.645	13.420	13.440	12.900	11.290	8.795	10.347
75	8.795	8.990	8.840	8.625	8.625	8.730	10.920	12.145	11.995	11.730	9.320	9.000	9.810
76	9.250	9.950	9.760	9.145	9.130	9.280	10.120	12.510	13.075	12.115	9.450	8.870	10.221
77	8.930	9.875	9.630	9.510	9.632	10.037	13.259	13.375	12.924	12.674	11.451	8.946	10.854
78	8.961	9.037	9.199	8.916	8.848	10.059	13.036	13.183	13.122	13.061	11.787	8.992	10.683
79	8.946	9.144	8.839	8.625	8.505	8.505	8.780	13.080	13.645	13.175	11.915	9.255	10.201
80	8.810	8.945	8.685	8.580	8.580	10.546	11.689	13.457	13.731	13.228	12.756	11.171	10.848
81	8.992	9.053	9.479	9.418	9.693	11.832	11.796	13.510	13.753	12.533	10.150	9.144	10.779
82	8.900	9.174	8.800	8.620	8.790	8.810	10.303	12.400	12.830	11.200	9.360	9.010	9.850
83	9.320	9.250	8.650	9.030	8.870	8.730	10.170	11.880	12.710	13.710	12.880	11.330	10.544
84	9.050	8.990	9.110	9.450	9.210	9.960	12.630	13.650	13.810	13.550	11.980	9.560	10.913
85	9.540	9.890	9.110	9.080	9.160	9.410	11.860	13.690	14.100	13.800	12.570	9.760	10.998
86	9.500	9.820	9.170	9.170	9.170	9.530	10.060	12.460	12.370	14.470	13.390	11.780	10.908
87	9.480	9.440	9.070	9.060	9.160	9.370	10.110	14.620	14.290	12.920	-	-	10.752
AVERAGE	9.330	9.326	9.097	8.983	9.000	9.522	11.089	12.814	13.038	12.697	11.330	9.781	10.517

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MEAN W.L. AT NAWHATA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
61	-	-	-	9.347	9.641	10.801	11.108	12.199	12.781	12.703	12.064	10.884	11.281
62	10.120	9.508	9.274	9.096	9.275	9.640	11.162	12.244	12.640	12.119	11.120	10.237	10.536
63	10.004	9.999	9.732	9.361	9.450	9.909	11.599	12.763	12.902	12.940	12.825	11.739	11.102
64	10.835	10.559	10.263	9.996	10.040	10.235	12.450	13.744	13.477	13.306	12.611	11.395	11.576
65	10.326	9.906	9.754	9.580	9.246	9.643	13.350	13.695	13.671	12.644	11.379	9.586	11.065
66	9.263	9.043	8.878	8.736	8.752	9.455	11.154	12.088	13.340	12.834	11.807	10.242	10.466
67	9.130	8.951	8.902	8.883	8.929	9.645	11.655	12.418	12.275	12.391	11.334	9.820	10.361
68	9.365	9.148	9.009	8.825	8.962	10.838	13.332	13.493	12.614	12.985	11.973	10.118	10.889
69	9.324	9.118	8.994	8.869	9.079	10.531	12.087	13.344	13.842	13.828	12.818	11.874	11.142
70	10.927	9.937	9.170	8.855	9.040	10.105	11.645	13.423	13.082	12.912	11.920	10.126	10.929
71	9.070	8.917	-	-	-	-	-	-	-	-	-	-	8.994
72	-	-	-	8.681	8.741	9.390	10.153	12.173	12.704	12.012	10.521	9.370	10.416
73	9.138	8.998	8.807	8.616	9.440	11.237	13.191	13.239	13.259	13.512	12.224	10.319	10.998
74	9.133	9.024	8.805	8.725	9.601	10.119	11.967	13.899	13.606	13.368	12.132	9.846	10.852
75	9.445	9.169	9.072	8.721	8.740	9.307	11.670	12.466	12.211	12.204	10.591	9.119	10.226
76	9.494	10.145	9.956	9.389	9.837	9.856	11.803	13.331	13.358	12.734	11.079	8.960	10.829
77	9.468	9.947	9.833	9.594	10.466	11.301	13.605	13.595	13.252	12.982	12.142	9.970	11.346
78	9.013	9.387	9.364	9.260	9.672	11.677	13.175	13.440	13.566	13.614	12.475	10.368	11.251
79	9.206	9.318	9.191	8.705	8.579	8.963	10.589	13.655	13.858	13.673	12.542	10.768	10.754
80	8.991	9.069	8.950	8.623	9.505	11.860	12.370	13.723	13.956	13.755	13.318	12.032	11.346
81	9.704	9.518	9.563	10.015	10.264	12.462	13.124	13.784	14.011	13.117	11.734	9.373	11.389
82	9.294	9.383	9.098	8.713	8.847	9.932	11.361	12.936	12.949	12.120	9.918	9.603	10.346
83	9.859	9.557	8.887	9.098	9.220	9.097	11.355	12.296	13.138	14.100	13.366	12.169	11.012
84	9.821	9.140	9.293	9.601	9.452	12.008	13.275	13.876	14.318	14.062	12.810	10.610	11.522
85	10.013	10.070	9.504	9.420	9.603	10.269	13.010	13.960	14.319	14.072	13.223	11.283	11.562
86	9.796	9.983	9.591	9.393	9.895	9.666	12.200	12.200	13.081	14.915	13.906	12.660	11.441
87	10.365	9.641	9.188	9.279	9.544	9.671	12.835	14.919	14.668	13.520	-	-	11.363
AVERAGE	9.644	9.497	9.295	9.130	9.318	10.293	12.124	13.189	13.342	13.170	12.073	10.499	10.988

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2. RAINFALL ANALYSIS

2-1. Rainfall

2-1-1. Long-term Trend of Annual Rainfall

In order to verify a droughtness in the recent years, a long-term rainfall in annual basis has been collected from 1920 to 1987 as shown in TABLE II-2-1. 11 years out of 67 years records are not available so 56 years records are available. A trend analysis will be rather difficult to be adopted with these incomplete data.

The average annual rainfall for 56 years is 1,397.5 mm. The latest ten years (1977/78 to 1986/87) average annual rainfall is 1,523.0 mm and the previous ten years (1967/68 to 1976/77) one is 1,301.5 mm which is rather lower side than the long-term average. Among the 25 year record from 1962/63 to 1986/87, the minimum value is 959.0 mm in 1982/83 and the second minimum is 974.0 in 1974/75. Accordingly the drought year in 1982/83 can be included in the latest 10-year period. In addition, the Farakka barrage has been started the operation since 1975, therefore the hydrological conditions before 1975 and after the year has been changed as studied in the later paragraph. Hydrological study should not be mixed with the above two different conditions. Therefore, the recent 10-year from 1977 to 1986 has been selected for the hydrological studies for the Project.

TABLE II-2-1 THE ANNUAL RAINFALL AT RAJSHAHI

Year	Annual Rainfall	Year	Annual Rainfall	Year	Annual Rainfall	Year	Annual Rainfall	Year	Annual Rainfall	Year	Annual Rainfall	Year	Annual Rainfall
		1927/28	829.0	1937/38	1,470.0	1947/48	1,727.0	1957/58	937.0	1967/68	992.0	1977/78	1,691.0
		1928/29	2,144.0	1938/39	1,884.0	1948/49	1,081.0	1958/59	816.0	1968/69	1,239.0	1978/79	1,603.0
		1929/30	1,493.0	1939/40	2,065.0	1949/50	-	1959/60	-	1969/70	1,745.0	1979/80	1,751.6
1920/21	1,096.0	1930/31	1,309.0	1940/41	823.0	1950/51	-	1960/61	-	1970/71	1,428.0	1980/81	1,901.9
1921/22	1,486.0	1931/32	-	1941/42	1,791.0	1951/52	890.0	1961/62	-	1971/72	1,436.0	1981/82	1,637.0
1922/23	1,445.0	1932/33	-	1942/43	1,833.0	1952/53	1,071.0	1962/63	1,106.0	1972/73	1,102.0	1982/83	959.0
1923/24	1,002.0	1933/34	1,835.0	1943/44	-	1953/54	1,063.0	1963/64	1,202.0	1973/74	1,875.0	1983/84	1,209.8
1924/25	-	1934/35	876.0	1944/45	1,139.0	1954/55	1,137.0	1964/65	2,091.0	1974/75	974.0	1984/85	1,579.3
1925/26	-	1935/36	1,119.0	1945/46	1,997.0	1955/56	1,250.0	1965/66	1,744.0	1975/76	1,012.0	1985/86	1,199.6
1926/27	1,429.0	1936/37	1,650.0	1946/47	-	1956/57	1,740.0	1966/67	1,466.0	1976/77	1,212.0	1986/87	1,698.2
Average	1,291.6	Average	1,404.4	Average	1,625.3	Average	1,244.9	Average	1,337.4	Average	1,301.5	Average	1,523.0 1,397.5

Note : The annual total rainfall shows the total rainall from April to March is the next year.