

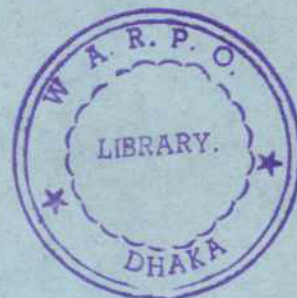
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Government of the People's Republic of Bangladesh

**South East Region**  
**Water Resources Development Programme**  
**BGD/86/037**

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**Noakhali North Drainage and Irrigation Project**  
**Feasibility Study**  
**Volume 4 - Annex E**  
**Agriculture**

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**NOAKHALI NORTH DRAINAGE AND IRRIGATION PROJECT  
FEASIBILITY STUDY**

**ANNEX E - AGRICULTURE**

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## CHAPTER E.1

### INTRODUCTION

#### E.1.1 Objective

Annex E presents the present condition of agriculture in the Noakhali North project area as well as the future agricultural development proposals based on the possible intervention for flood control and drainage improvement together with irrigation development.

#### E.1.2 Methodology

The principal sources of data used by the study were field investigations and Government statistics. The structure of the field surveys was designed to incorporate the division of the study area into four agro-ecological zones as shown in Figure E.1.1 on the premise of different flooding regimes and access to irrigation within each zone. Consequently much of the output from the surveys is presented by zone. The majority of surveys were based on questionnaires administered to a statistical sample of 12 randomly selected mouzas within each zone. Respondents were selected at random from lists of village inhabitants provided they fulfilled the requirements of the survey. Thus for example the farmer survey interviewed eight farmers in each mouza, picked at random until the predetermined quota for each farm size was fulfilled. The following surveys were completed :

1. A large-scale questionnaire survey of 384 farmers, with more detailed case studies of 50 of these farmers.
  2. A survey of 300 plots in the five 2 km square topo/hydrological survey areas (60 fields x 5 squares).
  3. A questionnaire survey of 96 fish pond operators.
  4. A questionnaire survey of 80 professional fishermen.
  5. A questionnaire survey of 96 landless people.
  6. A questionnaire survey of 96 irrigation pump operators.
  7. A questionnaire survey of 96 women.
  8. Environmental fieldwork.
  9. Health and Nutrition fieldwork.
  10. An inventory of infrastructure.
  11. Topographical survey of 5 sample squares.
- See plates E 1 and E 2.

Government statistics were collected from both District and Thana level offices, most notably from the Department of Agricultural Extension and the Bangladesh Bureau of Statistics. Other sources of information included banks, NGOs, parastatals and other consultants.





Plate E.1. Enumerators and Supervisor Collecting Information  
in connection with Agricultural Plot Survey

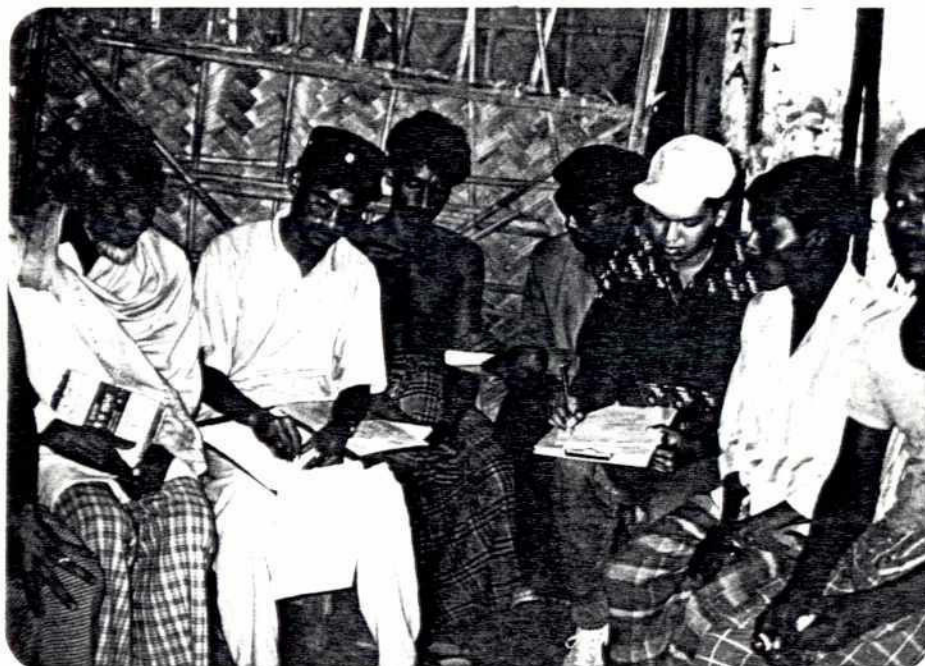
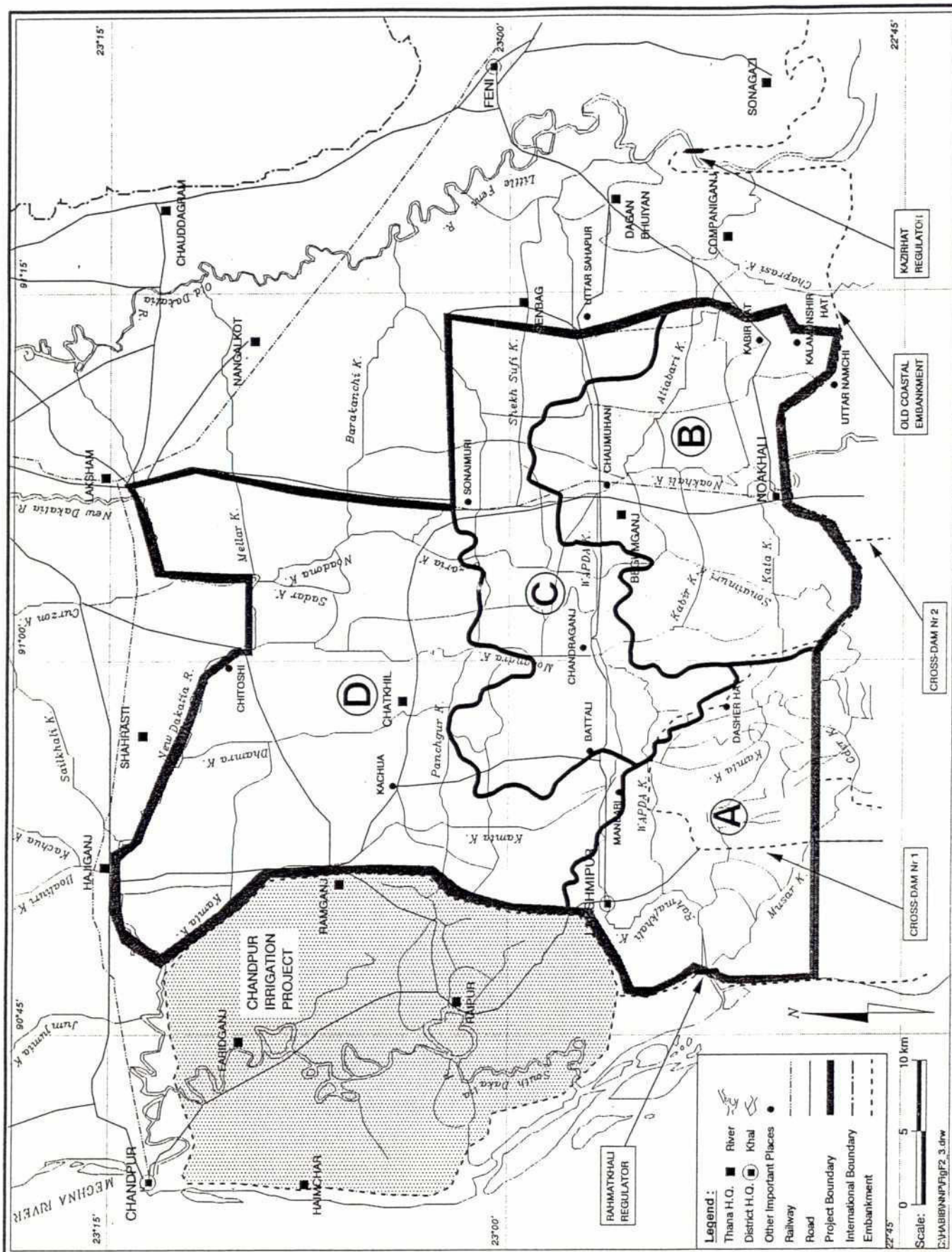


Plate E.2. Enumerators Collecting Information from Farmers  
in connection with Agro-Socio-Economy Survey

**Figure E.1.1**  
**Planning Zones**





## CHAPTER E.2

### SOILS AND LAND CAPABILITIES

#### E.2.1 Introduction

This chapter describes physiographic units, Agro-Ecological Zones, soils and land capability in the Noakhali North Project area through review of the existing data and previous studies mainly (1) Reconnaissance Soil Survey, Noakhali District and Sadar North, Sadar South and Chandpur Subdivisions of Comilla District (Department of Soil Survey 1983), (2) Land Resources Appraisal of Bangladesh for Agricultural Development (FAO 1988), and (3) Draft Regional Plan Report of SERS (Annex I, 1992).

#### E.2.2 Agro-Ecological Region

The Noakhali North Project area is mainly extending over the floodplains of the Meghna river, which are divided into 3 main physiographic units, namely (1) Lower Meghna River Floodplain, (2) Young Meghna Estuarine Floodplain and (3) Old Meghna Estuarine Floodplain (See Figure E.2.1). Those physiographic units correspond to 3 Agro-Ecological Regions in terms of agricultural potentials, mainly, due to the different feature and characteristics of the physiography, topography, soil associations, soil moisture regime and climatic condition, according to the Agro-Ecological Zone (AEZs). The Agro-Ecological Regions in the area are briefly explained below.

TABLE E.2.1

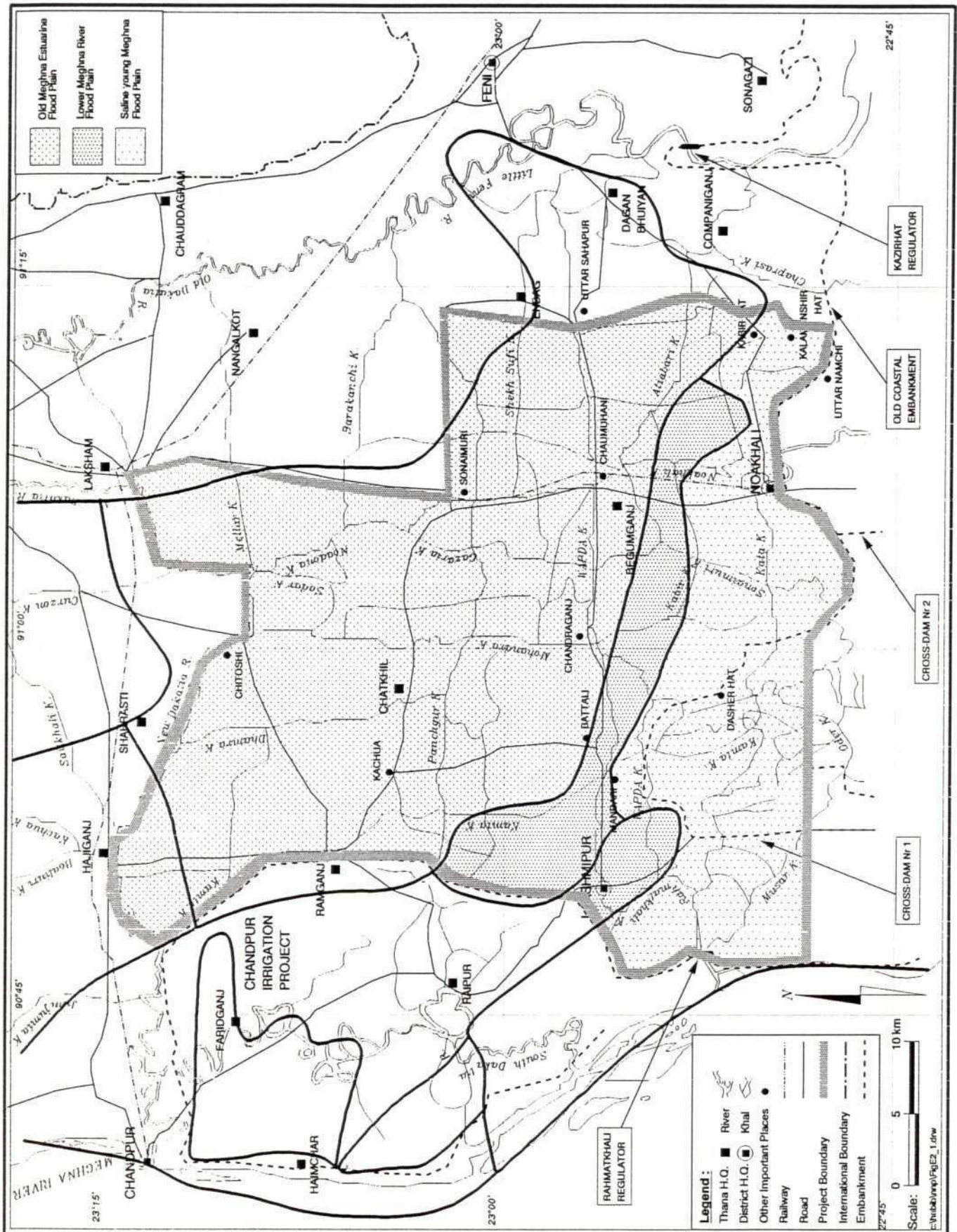
Agro-Ecological Region in the Noakhali North Project Area

| Agro-Ecological Region |                                   | Sub-Region |  |
|------------------------|-----------------------------------|------------|--|
| AEZ-17                 | Lower Meghna River Floodplain     | 19c:       | Non-calcareous, flood-protected        |
|                        |                                   | 19d:       | Non-calcareous, not flood-protected    |
| AEZ-18                 | Young Meghna Estuarine Floodplain | 18f:       | saline                                 |
| AEZ-19                 | Old Meghna Estuarine Floodplain   | 19a:       | Highland                               |
|                        |                                   | 19e:       | Very poorly drained; Laksham-Begumganj |

Note; Nos. of AEZs refer to the list of AEZs described in the Land Resources Appraisal of Bangladesh for Agricultural Development (FAO, 1988).



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**Lower Meghna River Floodplain (AEZ-17)** stretching along left bank of the Meghna river comprises older tidal deposits with irregular relief of gently undulating ridges and basins. Those are predominantly silty sometimes slightly calcareous, but not saline. Therefore, they are broadly divided into two sub-regions, the western part is slightly calcareous and the eastern portion is not calcareous. The Noakhali project area lies mainly on the non-calcareous area, and is further divided into two sub-regions depending on progress of the flood protection works (AEZ-17c:non-calcareous, flood-protected and AEZ-17d:non-calcareous, not flood-protected). Only the limited area of eastern part is classified into AEZ-17c, most of this Region is covered by the AEZ-17d of not protected area. Soils of this region are pre-dominantly deep silts. Soils on ridges are lighter than those in adjoining basins and depressions.

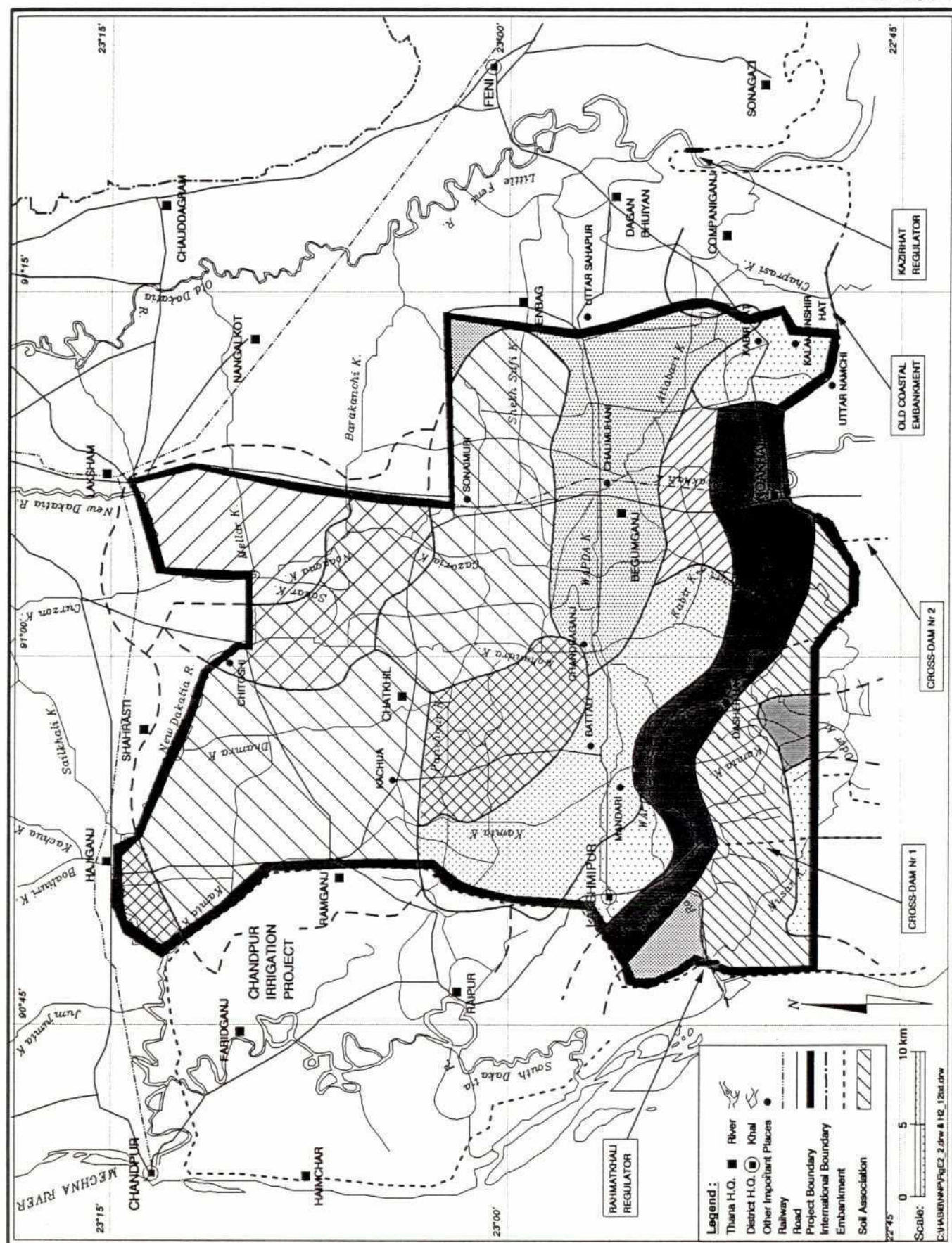
**Young Meghna Estuarine Floodplain (AEZ-18)** has been divided into six sub-regions, however, only one sub-region of saline area (AEZ-18f) extends into the southern part of the Noakhali project area from southern left bank of the Meghna to Feni river in the east. This area mainly comprises level char land and mud. The soils consist of finely stratified, calcareous, silty alluvium. Major part of the Noakhali project area is generally non-calcareous and less affected by salinity.

**Old Meghna Estuarine Floodplain (AEZ-19)** covers the northern part of the area. The landscape consists of an almost smoothed out plain of very low relief with broad ridges and extensive shallow basins. Out of ten sub-regions of this AEZ, the Noakhali project area covers two sub-region of highland (AEZ-19a) and very poor drained: Laksham-Begumganj (AEZ-19e). Sub-region 19a has predominantly deep silty soils which depressions are moderately deeply flooded mainly by rainwater. Sub-region 19e has deep silty soils similar to AEZ-19a, but greater portion is moderately flooded. Silty soils are predominant in both of the sub-regions.

### **E.2.3 Soil Associations and Land Capability**

According to the existing data, there are 14 soil associations consisting of 10 soil series extending over the project area, as shown in Table E.2.2 and Figure E.2.2. These soil associations consist of 10 soil series. Apart from some soil salinity occurring in the southern edge of the area, the principal determinants of agricultural development are the flooding regime and availability of irrigation, rather than any intrinsic soil properties. Table E.2.3 and Figure E.2.3 show the land capability classes of each soil association and the land capability associations as main governing factors are listed in Table E.2.4. Most of the soil associations within the area fall into land capability class II. The area of class III in the south-west suffers from slight salinity limitation, and the small area of class IV from a low tidal surge risk. Reconnaissance soil survey conducted during 1965 to 1966 is only available for crop suitability classification concerning the project area. For the wet and dry land crops, most of the soil association were well to moderately suitable except Ramgati series as shown in Table E.2.5.







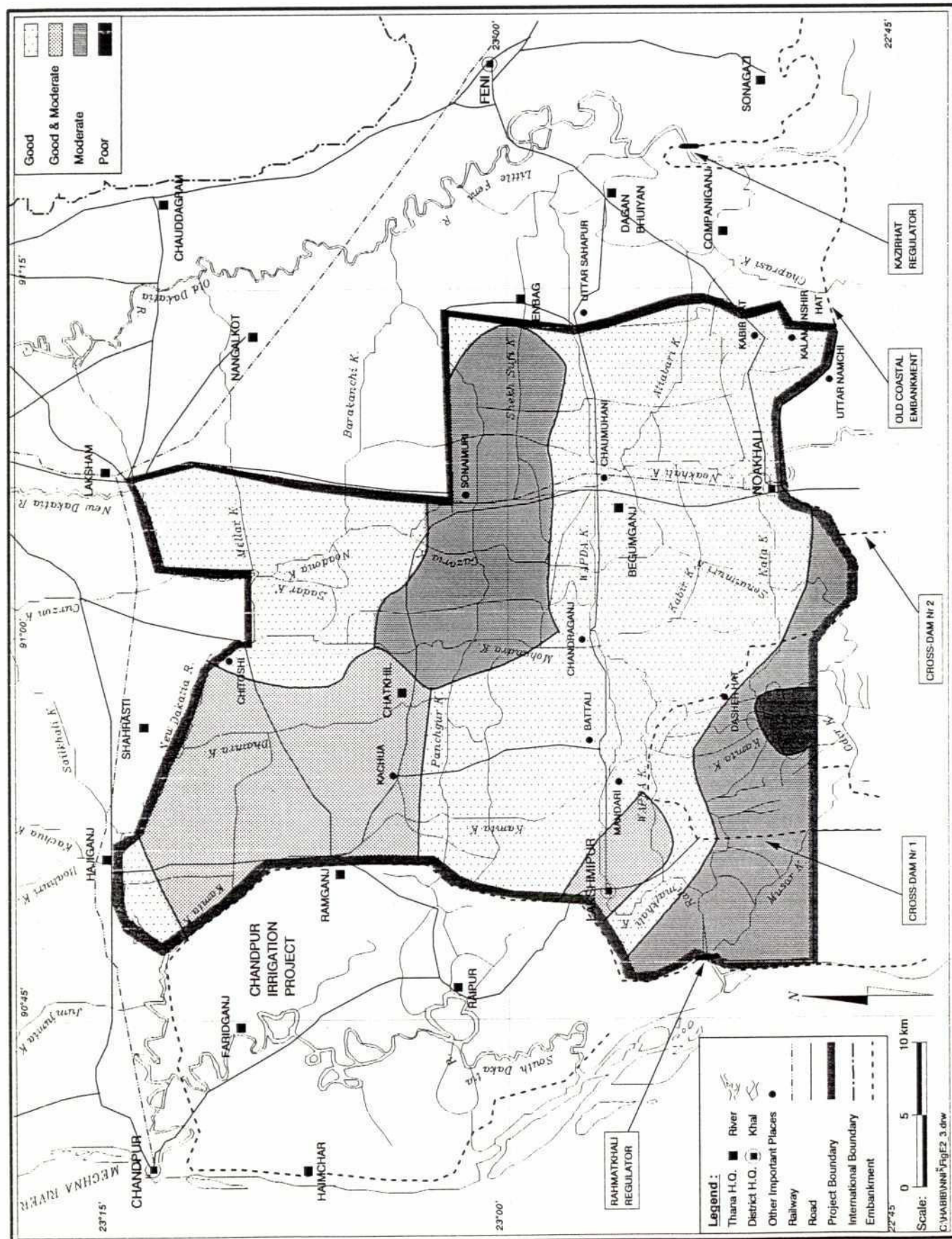


TABLE E.2.2

## Soil Association in the Noakhali North Project Area

| AEZs and AEZ Sub-Regions* |  |    | Soil Association**  | Gross Area |                   |
|---------------------------|--|----|---|------------|-------------------|
|                           |  |    |   | Ha         | % of Project Area |
| AEZ-17:                   | Lower Meghna River Floodplain            |    |   |            |                   |
| 17c                       | Non-calcareous, flood protected          | 80 | Burichang-Debidwar  | 1927       | 1.2               |
|                           |  | 91 | Paikpara-Debidwar   | 2268       | 1.4               |
|                           |  | 92 | Noakhali Series   | 3377       | 2.1               |
| 17d                       | Non-calcareous, not flood protected      | 90 | Paikpara-Chandraganj  | 4342       | 2.7               |
|                           |  | 91 | Paikpara-Debidwar   | 14296      | 8.9               |
| AEZ-18:                   | Young Meghna Estuarine Floodplain        |    |   |            |                   |
| 18f                       | Saline: Meghna & Noakhali Estuarine Mud. | 96 | Ramgati undeveloped, cultivated-Chandraganj                     | 16242      | 10.1              |
|                           |  | 97 | Ramgati undeveloped-Hatiya slightly developed, cultivated phase | 8041       | 5.0               |
|                           |  | 98 | Ramgati: undeveloped, cultivated                                | 14152      | 8.8               |
|                           |  | 99 | Ramgati: undeveloped, uncultivated                              | 1608       | 1.0               |
|                           |  |    |   |            |                   |
| AEZ-19:                   | Old Meghna Estuarine Floodplain          |    |   |            |                   |
| 19a                       | Highland                                 | 68 | Tippera-Dhamti  | 1286       | 0.8               |
| 19e                       | Very poor drainage: Laksham-Begumganj    | 57 | Barura-Burichang  | 9649       | 6.0               |
|                           |  | 61 | Tippera-Debidwar  | 11739      | 7.3               |
|                           |  | 62 | Dhamti-Debidwar   | 9810       | 6.1               |
|                           |  | 77 | Debidwar-Chandraganj  | 19137      | 11.9              |
|                           |  | 78 | Debidwar-Paikpara   | 19780      | 12.3              |
|                           |  | 80 | Burichang-Debidwar  | 23160      | 14.4              |
|                           |  |    | Total:  | 160814     | 100.0             |

Remarks: \* : Nos. of AEZs refer to the list of AEZs described in the Land Resources Appraisal of Bangladesh for Agricultural Development (FAO, 1988).

\*\* : Numbers of soil association correspond the numbers in Annex I Soils of the Draft Region Plan Report, FAP-5, April 1992.

Source: (1) Annex I Soils of the Draft Region Plan Report, FAP-5, April 1992. (2) Album of Drawing of the Draft Region Plan Report, FAP-5, March 1992.



TABLE E.2.3

**Land Capability Association and Capability Class  
in the Noakhali North Project Area**

| AEZs/AEZ Sub-Regions<br>Soil Association* |                    |                                     | Land Capability<br>Association**                                    | Capability<br>Class*** |          |
|---|--------------------|-------------------------------------|---|------------------------|----------|
| AEZ                                       | 17:                | Lower Meghna River Floodplain       |   |                        |          |
|   |                    | 17c                                 | Non-calcarious, flood protected                                     |                        |          |
|   |                    | 80                                  | Burichang-Debidwar  | 41                     | II & III |
|   |                    | 91                                  | Paikpara-Debidwar   | 29                     | II       |
|   |                    | 92                                  | Noakhali Series   | 40                     | II & III |
|   | 17d                | Non-calcarious, not flood protected |   |                        |          |
|   |                    | 90                                  | Paikpara-Chandraganj  | 29                     | II       |
|   |                    | 91                                  | Paikpara-Debidwar   | 27 & 29                | II       |
|   | AEZ                | 18:                                 | Young Meghna Estuarine Floodplain                                   |                        |          |
|   |                    | 18f                                 | Saline:Meghna & Noakhali Estuarine Mud.                             |                        |          |
| 96  |                    |                                     | Ramgati undeveloped, cultivated<br>-Chandraganj                     | 29                     | II       |
| 97  |                    |                                     | Ramgati undeveloped<br>-Hatiya slightly developed, cultivated phase | 29                     | II       |
| 98  |                    |                                     | Ramgati:undeveloped, cultivated                                     | 43                     | III      |
| 99  |                    |                                     | Ramgati   | 47                     | IV       |
| 19:                                       |                    |                                     | Old Meghna Estuarine Floodplain                                     |                        |          |
|   |                    | 19a                                 | Highland  |                        |          |
|   |                    |                                     | 68  | Tippera-Dhamti         | 29       |
|   |                    | 19e                                 | Very poor drainage:Laksham-Begumganj                                |                        |          |
|   | 57                 |                                     | Barura-Brichang   | 29                     | II       |
|   | 61                 |                                     | Tippera-Debidwar  | 29                     | II       |
|   | 62                 |                                     | Dhamti-Debidwar   | 29                     | II       |
|   | 77                 |                                     | Debidwar-Chandraganj  | 29                     | II       |
| 78  | Debidwar-Paikpara  |                                     | 40 & 41   | II & III               |          |
| 80  | Burichang-Debidwar | 41                                  | II & III  |                        |          |

Remarks: \* : Numbers of soil association correspond the numbers in Table E.2.2 and in Annex I Soils of the Draft Region Plan Report, FAP-5, April 1992.

\*\* : Numbers of capability association corresponds the numbers in Annex I Soils of the Draft Region Plan Report, FAP-5, April 1992.

\*\*\* : Capability classes indicate class I : very good agricultural land, class II : good agricultural land, class III : moderate agricultural land, class IV : poor agricultural land, class V : non-agricultural land.

Source: (1) Annex I Soils of the Draft Region Plan Report, FAP-5, April 1992. (2) Album of Drawing of the Draft Region Plan Report, FAP-5, March 1992.



TABLE E.2.4

Land Capability Class and Land Capability Associations

| Land Capability Class* |                                   | Gross Area<br>Ha      % of<br>Project Area |       | Land Capability Association** |  |
|------------------------|-----------------------------------|--|-------|-------------------------------|--|
| II                     | Good agricultural land            | 96,810                                     | 60.2  | 27                            | very good and good agricultural land, partly shallowly flooded, part moderately deeply flooded                   |
|                        |                                   |  |       | 29                            | Predominantly good agricultural land, mainly moderately deeply flooded   |
| II & III               | Good & moderate agricultural land | 24,655                                     | 15.3  | 40                            | Moderately well drained terrace with some imperfect drained valleys  |
|                        |                                   |  |       | 41                            | Moderate and good agricultural land, seasonally moderately deeply flooded, part slow draining in the dry season. |
| III                    | Moderate agricultural land        | 37,741                                     | 23.5  | 43                            | Predominantly moderate agricultural land, seasonally shallowly flooded, slightly to moderately saline            |
| IV                     | Poor agricultural land            | 1,608                                      | 1.0   | 47                            | Predominantly poor agricultural land, seasonally shallow flooded, with severe hazard of damage from storm surges |
| Total:                 |                                   | 160,814                                    | 100.0 |                               |  |

Remarks:      \* :      Capability classes indicate class I : very good agricultural land, class II : good agricultural land, class III : moderate agricultural land, class IV : poor agricultural land, class V : non-agricultural land.

                 \*\* :      Numbers of capability association corresponds the numbers in Annex I Soils of the Draft Region Plan Report, FAP-5, April 1992.

Source:                      (1) Annex I Soils of the Draft Region Plan Report, FAP-5, April 1992. (2) Album of Drawing of the Draft Region Plan Report, FAP-5, March 1992.

TABLE E.2.5

Land Capability and Crop Suitability Rating of  
Soil Series in the Noakhali North Project Area

| Soil Series                                  | Phase, Variant or Land Type     | Land Capability | Crop Suitability** |   |   |                    |   |   |   |   |   |   |  |
|--|---------------------------------|-----------------|--------------------|---|---|--------------------|---|---|---|---|---|---|--|
|  |                                 |                 | Wet land crops***  |   |   | Dry land crops**** |   |   |   |   |   |   |  |
|  |                                 | A               | B                  | C | D | E                  | F | G | H | I | J | K |  |
| Barura,                                      | shallowly flooded phase         | 1               | -                  | 1 | 3 | 1                  | 2 | 1 | 2 | 1 | 2 | 1 |  |
|  | moderately deeply flooded phase | 1               | 1                  | 4 | 3 | 1                  | 3 | 1 | 2 | 2 | 2 | 1 |  |
|  | moderately deeply flooded phase | 2               | 1                  | 4 | 1 | 2                  | 4 | 2 | 3 | 3 | 3 | 3 |  |
|  | deeply flooded phase            | 2               | 1                  | 4 | 1 | 3                  | 4 | 2 | 3 | 3 | 4 | 3 |  |
| Burichang,                                   | slow draining phase             | 2               | 1                  | 4 | 1 | 3                  | 4 | 2 | 3 | 3 | 4 | 3 |  |
|  |                                 | 2               | 3                  | 2 | 2 | 2                  | 1 | 2 | 2 | 2 | 2 | 2 |  |
|  | shallowly flooded phase         | 1               | 1                  | 3 | 1 | 2                  | 1 | 2 | 2 | 2 | 2 | 2 |  |
|  | moderately deeply flooded phase | 2               | 1                  | 4 | 1 | 2                  | 2 | 2 | 3 | 3 | 3 | 3 |  |
| Chandraganj                                  | slow draining phase             | 2               | 1                  | 4 | 1 | 3                  | 4 | 3 | 4 | 4 | 4 | 4 |  |
|  |                                 | 1               | 1                  | 3 | 2 | 1                  | 1 | 1 | 1 | 1 | 1 | 1 |  |
|  | shallowly flooded phase         | 1               | 1                  | 4 | 2 | 1                  | 2 | 2 | 2 | 2 | 2 | 2 |  |
|  | moderately deeply flooded phase | 3               | -                  | 2 | 4 | 3                  | 3 | 2 | 3 | 3 | 3 | 2 |  |
| Dhamti,                                      | developed, cultivated phase     | 2               | -                  | 2 | 3 | 2                  | 2 | 1 | 1 | 1 | 1 | 1 |  |
|  | early draining phase            | 2               | -                  | 2 | 3 | 2                  | 2 | 1 | 1 | 1 | 1 | 1 |  |
|  | slow draining phase             | 2               | 1                  | 4 | 1 | 3                  | 4 | 3 | 4 | 3 | 4 | 3 |  |
|  | undeveloped, cultivated         | 3               | -                  | 2 | 4 | 3                  | 4 | 3 | 3 | 3 | 3 | 3 |  |
| Hatiya, slightly developed, cultivated phase | undeveloped, uncultivated       | 4               | -                  | 3 | 4 | 4                  | 4 | 4 | 4 | 4 | 4 | 4 |  |
|  | shallowly flooded phase         | 1               | 1                  | 1 | 3 | 1                  | 1 | 1 | 1 | 1 | 1 | 1 |  |
|  | moderately deeply flooded phase | 1               | -                  | 4 | 3 | 1                  | 2 | 1 | 1 | 1 | 2 | 1 |  |
|  |                                 | 1               | -                  | 4 | 3 | 1                  | 1 | 1 | 1 | 1 | 2 | 1 |  |

Remarks\* : land capability I : very good agricultural land, II : good agricultural land, III : moderate agricultural land, IV : poor agricultural land,

V : non-agricultural land

\*\* : crop suitability class 1 : well suited, class 2 : moderately suited, class 3 : poorly suited, class 4 : not suited

\*\*\* : wet land crops A : Aus, B : Broadcast Aman, C : Transplanted Aman, D : Boro, F : Jute

\*\*\*\* : dry land crops E : Wheat, F : Millets, G : Chillies, H : Legumes, I : Tobacco & Vegetables, J : Oilseeds

Source; Reconnaissance Soil Survey Report (1965-1966), revised edition 1970, reprinted in 1983.



## CHAPTER E.3

### PRESENT SITUATION

#### E.3.1 Structure of Farming

The demographic data shows that the total number of households in the area is estimated at about 410,600 (5.85 person per household) with a population density of 1,330 persons per square km in 1993. Livelihood of households rely mainly on agriculture, since urban population is limited to less than 10%. The structure of farm households shows a wide variation of farm size, land ownership, tenancy as mentioned below. Most of the data are collected from the current farmer survey compiled in the appendices of this Annex and supplemented by the secondary data.

According to the farm size distribution estimated based on the tax-lists of sample mouzas, the area is characterized by large portions of small and marginal farmers which accounts for 83% of the total farm households. Land ownership is unequally distributed with 55% of land owned by 17% of the households who are categorized in large and medium farms, as shown below;

TABLE E.3.1

#### Farm Size Distribution

|                       | Farm Size Category and Operated Area |                          |                          |                  | Total  |
|-----------------------|--------------------------------------|--------------------------|--------------------------|------------------|--------|
|                       | Marginal<br>0.02 to 0.2 ha.          | Small<br>>0.2 to 1.0 ha. | Medium<br>>1.0 to 3.0 ha | Large<br>>3.0 ha |        |
| Percentage of farmers | 27.9%                                | 55.2%                    | 14.0%                    | 2.9%             | 100.0% |
| Areal distribution    | 5.1%                                 | 40.4%                    | 38.3%                    | 16.2%            | 100.0% |

According to the 1981 census data, more than 50% of the total households were "landless" farmers who own less than 0.02 ha of farm land. The proportion of landless farmers may increase due to the high growth rate of population. Tenancy of cultivated land is categorized by owned land or rented land in the form of share-cropping and mortgage. According to the farmer survey, about 70% of cultivable land is cultivated by land owner, however, 30% is cultivated by tenants through a share-cropping basis in most cases. The result shows that land rented-out is far more than rented-in, and this indicates that landless farmers may cultivate about 16.3% of total cultivable land which is balanced from rented-out (29.9%) to rented-in (13.6%). Tenure arrangement of farm land is shown in Table E.3.4 and summarised as follows:

TABLE E.3.2

Total Tenure Arrangement of Farm Land by Farmer Survey

|       | Owned<br>Cultivated Land<br>(A) | Area<br>Rented-Out<br>(B) | Area<br>Rented-In<br>(C) | Total<br>Cultivated Area<br>(A) - (B) + (C) |
|-------|---------------------------------|---------------------------|--------------------------|---|
| Area  | 378.0 ha                        | 112.9 ha                  | 51.5 ha                  | 316.5 ha                                    |
| Ratio | 100.0%                          | 29.9%                     | 13.6%                    | 83.7%                                       |

Average farm size of sample farm households is estimated at 0.82 ha per household consisting of 0.14 ha for marginal, 0.52 ha for small, 1.78 ha for medium and 4.41 ha for large farm size, as shown below;

TABLE E.3.3

Average Farm Size

(Unit:ha)

| Planning<br>Zone | Farm Size Category and Operated Area |                         |                          |                  | Average |
|------------------|--------------------------------------|-------------------------|--------------------------|------------------|---------|
|                  | Marginal<br>0.02 to 0.2 ha           | Small<br>>0.2 to 1.0 ha | Medium<br>>1.0 to 3.0 ha | Large<br>>3.0 ha |         |
| Zone A           | 0.12                                 | 0.53                    | 1.83                     | 5.75             | 1.01    |
| Zone B           | 0.15                                 | 0.53                    | 1.69                     | 3.26             | 0.73    |
| Zone C           | 0.13                                 | 0.49                    | 1.72                     | 3.33             | 0.74    |
| Zone D           | 0.15                                 | 0.55                    | 1.90                     | 3.93             | 0.81    |
| Whole Area       | 0.14                                 | 0.52                    | 1.78                     | 4.41             | 0.82    |



TABLE E.3.4

## Tenure Arrangement and Average Farm Size

| Planning Zone | Farm Size Category             | Total Area Owned (ha) | Area not Cultivated (ha) | Owned Cultivable Area (ha) | Total Rented out (ha) | Total Rented in (ha) | Total Cultivated Area (ha) | No of Farms (Nos) | Average Farm Size (ha) |
|---------------|--------------------------------|-----------------------|--------------------------|----------------------------|-----------------------|----------------------|----------------------------|-------------------|------------------------|
| Zone A        | Marginal                       | 2.85                  | 1.36                     | 1.49                       | 0.00                  | 0.12                 | 1.61                       | 13                | 0.12                   |
|               | Small                          | 38.70                 | 8.13                     | 30.57                      | 8.00                  | 6.34                 | 28.90                      | 55                | 0.53                   |
|               | Medium                         | 57.59                 | 5.98                     | 51.61                      | 18.43                 | 10.74                | 43.92                      | 24                | 1.83                   |
|               | Large                          | 33.52                 | 1.89                     | 31.63                      | 13.97                 | 5.34                 | 23.01                      | 4                 | 5.75                   |
|               | Total                          | 132.66                | 17.37                    | 115.29                     | 40.40                 | 22.54                | 97.43                      | 96                | 1.01                   |
|               | Ratio to owned cultivated land |                       |                          | 100.0%                     | 35.0%                 | 19.5%                | 84.5%                      |                   |                        |
| Zone B        | Marginal                       | 9.34                  | 4.70                     | 4.64                       | 1.87                  | 0.22                 | 2.98                       | 20                | 0.15                   |
|               | Small                          | 51.90                 | 9.81                     | 42.09                      | 18.94                 | 5.42                 | 28.58                      | 54                | 0.53                   |
|               | Medium                         | 49.72                 | 9.09                     | 40.63                      | 11.22                 | 6.03                 | 35.45                      | 21                | 1.69                   |
|               | Large                          | 4.07                  | 0.81                     | 3.26                       | 0.00                  | 0.00                 | 3.26                       | 1                 | 3.26                   |
|               | Total                          | 115.03                | 24.41                    | 90.61                      | 32.02                 | 11.67                | 70.26                      | 96                | 0.73                   |
|               | Ratio to owned cultivated land |                       |                          | 100.0%                     | 35.3%                 | 12.9%                | 77.5%                      |                   |                        |
| Zone C        | Marginal                       | 4.14                  | 1.51                     | 2.63                       | 0.12                  | 0.24                 | 2.75                       | 21                | 0.13                   |
|               | Small                          | 33.93                 | 7.50                     | 26.43                      | 5.75                  | 5.20                 | 25.88                      | 53                | 0.49                   |
|               | Medium                         | 51.94                 | 4.44                     | 47.51                      | 15.21                 | 0.33                 | 32.63                      | 19                | 1.72                   |
|               | Large                          | 11.77                 | 1.13                     | 10.63                      | 0.63                  | 0.00                 | 10.00                      | 3                 | 3.33                   |
|               | Total                          | 101.77                | 14.58                    | 87.19                      | 21.70                 | 5.78                 | 71.27                      | 96                | 0.74                   |
|               | Ratio to owned cultivated land |                       |                          | 100.0%                     | 24.9%                 | 6.6%                 | 81.7%                      |                   |                        |
| Zone D        | Marginal                       | 3.25                  | 1.27                     | 1.98                       | 0.59                  | 0.85                 | 2.24                       | 15                | 0.15                   |
|               | Small                          | 40.56                 | 8.07                     | 32.49                      | 8.02                  | 8.85                 | 33.32                      | 61                | 0.55                   |
|               | Medium                         | 46.45                 | 4.85                     | 41.60                      | 9.20                  | 1.77                 | 34.17                      | 18                | 1.90                   |
|               | Large                          | 9.32                  | 0.50                     | 8.82                       | 0.97                  | 0.00                 | 7.85                       | 2                 | 3.93                   |
|               | Total                          | 99.58                 | 14.68                    | 84.90                      | 18.78                 | 11.46                | 77.57                      | 96                | 0.81                   |
|               | Ratio to owned cultivated land |                       |                          | 100.0%                     | 22.1%                 | 13.5%                | 91.4%                      |                   |                        |
| Total         | Marginal                       | 19.58                 | 8.84                     | 10.73                      | 2.58                  | 1.43                 | 9.58                       | 69                | 0.14                   |
|               | Small                          | 165.09                | 33.51                    | 131.58                     | 40.71                 | 25.81                | 116.69                     | 223               | 0.52                   |
|               | Medium                         | 205.70                | 24.36                    | 181.34                     | 54.05                 | 18.87                | 146.16                     | 82                | 1.78                   |
|               | Large                          | 58.67                 | 4.33                     | 54.34                      | 15.57                 | 5.34                 | 44.12                      | 10                | 4.41                   |
|               | Total                          | 449.04                | 71.04                    | 378.00                     | 112.90                | 51.45                | 316.54                     | 384               | 0.82                   |
|               | Ratio to owned cultivated land |                       |                          | 100.0%                     | 29.9%                 | 13.6%                | 83.7%                      |                   |                        |

### E.3.2 Land Use

The Noakhali North Project area consisting of four planning zones covers approximately 160,814 ha in gross area extending over three Thanas in Lakshmipur District (51,664 ha or 32% of the total area), four Thanas in Noakhali (80,150 ha or 50%), three Thanas in Chandpur (14,625 ha or 9%) and one Thana in Comilla (14375 or 9%) The gross area by Thana is shown below:

TABLE E.3.5

#### Gross Area by Thana

| (Unit:ha)       |               |        |        |        |         |
|-----------------|---------------|--------|--------|--------|---------|
| Name of         | Planning Zone |        |        |        |         |
| Thana           | A             | B      | C      | D      | Total   |
| Lakshmipur      | 22,326        | -      | 7,541  | 6,930  | 36,797  |
| Chatkhil        | -             | -      | 2,864  | 10,206 | 13,070  |
| Ramgati         | 3,078         | -      | -      | 11,789 | 14,867  |
| Begumganj       | -             | 16,570 | 17,695 | 5,235  | 39,500  |
| Sudharan-       | 3,928         | 17,464 | 108    | -      | 21,500  |
| Senbagh         | -             | 1,519  | 4,561  | -      | 6,080   |
| Laksham         | -             | -      | -      | 14,375 | 14,375  |
| Shahrasti       | -             | -      | -      | 6,487  | 6,487   |
| Faridganj       | -             | -      | -      | 2,219  | 2,219   |
| Hajiganj        | -             | -      | -      | 5,919  | 5,919   |
| Gross Area (ha) | 29,332        | 35,553 | 32,769 | 63,160 | 160,814 |
| Ratio to total  | 18%           | 22%    | 20%    | 39%    | 100%    |

The gross area includes 52,200 ha (32% of the total area) of non-cultivable land of perennial water bodies, infrastructure and settlement area. Net cultivable area (NCA) is estimated at about 108,600 ha which accounts for 68% of the gross area. The following table shows distribution of the area by four planning zones.

In terms of the flood phase, 24% of the area is highland: F0 (flood depth of 0 to 30 cm), 20% medium highland: F1 (30 to 90 cm), and 56% medium lowland and lowland: F2&F3 (over 90 cm) as shown in Table E.3.7. Floods are mainly caused by excess rainfall during pre-monsoon and monsoon seasons, with some over spill in the north west of the area from the Dakatia. In addition to this, the cyclones bring wind damage for crops and tidal surges in the southern area. As for irrigation, LLPs are the main irrigation devices and groundwater resources are limited mainly to the north-eastern part since groundwater in the southern portion is mostly saline. The planning zones were chosen for the different flooding and inundation conditions according to the flood phase characteristics.



TABLE E.3.6

## NCA by Planning Zones

(Unit:ha)

| Item           | Planning Zone |              |              |              | Total          |
|----------------|---------------|--------------|--------------|--------------|----------------|
|                | A             | B            | C            | D            |                |
| Gross Area     | 29,332 (18%)  | 35,553 (22%) | 32,769 (20%) | 63,160 (39%) | 160,814 (100%) |
| NCA            | 22,956 (21%)  | 21,115 (20%) | 22,107 (20%) | 42,450 (39%) | 108,628 (100%) |
| Ratio to Gross | 78%           | 59%          | 67%          | 67%          | 68%            |

Source: Measurement by the Team

In Zone A which is located in the south-western part of the project area, is mostly F0 and F1, and there is no F2&F3 land. Zone A is not affected by severe flooding in the monsoon season. Zones B and C extend into the central to south-eastern portion of the project area, and almost half (53%) of the land is situated in F2&F3 which is mainly included in the Begumganj depression in Zone B. F0 and F1 land occupies about 47% of these planning zones. Zones B and C are very little affected by overspill flood from the Little Feni river in the pre-monsoon season but suffer flood by rainfall during the monsoon season. In Zone D which occupies the northern part and is bounded by the Dakatia river, 90% of the area is over 90 cm of flood depth (F2&F3) where Laksham depression is located. Part of this zone is subjected to flooding by spillage from the Dakatia river and the whole area is flooded by rainfall during the monsoon season. Accordingly, Zone A may be classified into higher land, Zones B and C medium to lower land and Zone D low land. Area by flood phase in the planning zones is summarized as follows:

TABLE E.3.7  
Area by Flood Phase

(Unit:ha)

| Flood Phase | NCA in Planning Zone |                  |                  |                  | Total             |
|-------------|----------------------|------------------|------------------|------------------|-------------------|
|             | A                    | B                | C                | D                |                   |
| F0          | 20,890<br>(91%)      | 845<br>(4%)      | 3,758<br>(17%)   | 425<br>(1%)      | 25,917<br>(24%)   |
| F1          | 2,066<br>(9%)        | 6,968<br>(33%)   | 8,622<br>(39%)   | 3,821<br>(9%)    | 21,476<br>(20%)   |
| F2&F3       | 0<br>(0%)            | 13,302<br>(63%)  | 9,727<br>(44%)   | 38,205<br>(90%)  | 61,235<br>(56%)   |
| Total       | 22,956<br>(100%)     | 21,115<br>(100%) | 22,107<br>(100%) | 42,450<br>(100%) | 108,628<br>(100%) |

Source: Estimation by study team

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Irrigation benefits vary every year depending on the rainfall and flooding conditions as well as on distribution of irrigation equipments. It is considered that irrigation coverage has expanded rapidly recently through development of STWs, DTWs by principally through LLPs. Irrigation coverage of the area is estimated using data obtained through farmer survey and AST data. Irrigation water is applied mainly for boro crops, and supplemental irrigation is made for rabi, aus and aman crops. Coverage of irrigation is high with approximately 49,900 ha or 46 % of the total NCA. Irrigation condition varies amongst the planning zones. Zones B, C and D are irrigated at around 50% of NCA, however, Zone A is less than 20% as shown in Table E.3.8. Irrigation condition by flood phase generally indicates that the irrigation rate is higher in the lower flood phases, as shown in Table E.3.9. Main mode of irrigation is LLPs, however, tubewells are also utilized in the north-eastern part where groundwater is not affected by saline severely. Irrigated area by flood phase in planning zones are shown in Table E.3.10.

**TABLE E.3.8**

**Irrigated Area by Planning Zones**

(Unit:ha)

| Condition | Planning Zone |               |               |               | Total          |
|-----------|---------------|---------------|---------------|---------------|----------------|
|           | A             | B             | C             | D             |                |
| Irrigated | 3,925 (17%)   | 10,769 (51%)  | 10,611 (48%)  | 24,673 (58%)  | 49,978 (46%)   |
| Rainfed   | 19,031 (83%)  | 10,346 (49%)  | 11,496 (52%)  | 17,777 (42%)  | 58,650 (54%)   |
| Total     | 22,956 (100%) | 21,115 (100%) | 22,107 (100%) | 42,450 (100%) | 108,628 (100%) |

Source: Estimation by Farmers Survey and AST data

**TABLE E.3.9**

**Irrigated Area by Flood Phase**

(Unit:ha)

| Condition | Land Type        |                  |                  | Total             |
|-----------|------------------|------------------|------------------|-------------------|
|           | F0               | F1               | F2 & F3          |                   |
| Irrigated | 3,449<br>(13%)   | 6,115<br>(29%)   | 40,414<br>(66%)  | 49,978<br>(46%)   |
| Rainfed   | 22,468<br>(87%)  | 15,361<br>(71%)  | 20,821<br>(34%)  | 58,650<br>(54%)   |
| Total     | 25,917<br>(100%) | 21,476<br>(100%) | 61,235<br>(100%) | 108,628<br>(100%) |

Source: Estimation by Farmers Survey and AST data

TABLE E.3.10

Irrigated Area by Flood Phase under Present Condition

(Unit:ha)

| Zone   | Condition | Flood Phase |        |        |        |        |        |        |        |
|--------|-----------|-------------|--------|--------|--------|--------|--------|--------|--------|
|        |           | NCA         |        | F0     |        | F1     |        | F2&F3  |        |
|        |           | Area        | Ratio  | Area   | Ratio  | Area   | Ratio  | Area   | Ratio  |
| Zone A | Irrigated | 3,925       | 17.1%  | 3,007  | 14.4%  | 918    | 44.4%  | 0      | -      |
|        | Rainfed   | 19,031      | 82.9%  | 17,883 | 85.6%  | 1,148  | 55.6%  | 0      | -      |
|        | Sub-total | 22,956      | 100.0% | 20,890 | 100.0% | 2,066  | 100.0% | 0      | 0.0%   |
|        |           | 100.0%      |        | 91.0%  |        | 9.0%   |        | 0.0%   |        |
| Zone B | Irrigated | 10,769      | 51.0%  | 0      | -      | 2,323  | 33.3%  | 8,446  | 63.5%  |
|        | Rainfed   | 10,346      | 49.0%  | 845    | 100.0% | 4,645  | 66.7%  | 4,856  | 36.5%  |
|        | Sub-total | 21,115      | 100.0% | 845    | 100.0% | 6,968  | 100.0% | 13,302 | 100.0% |
|        |           | 100.0%      |        | 4.0%   |        | 33.0%  |        | 63.0%  |        |
| Zone C | Irrigated | 10,611      | 48.0%  | 442    | 11.8%  | 2,874  | 33.3%  | 7,295  | 75.0%  |
|        | Rainfed   | 11,496      | 52.0%  | 3,316  | 88.2%  | 5,748  | 66.7%  | 2,432  | 25.0%  |
|        | Sub-total | 22,107      | 100.0% | 3,758  | 100.0% | 8,622  | 100.0% | 9,727  | 100.0% |
|        |           | 100.0%      |        | 17.0%  |        | 39.0%  |        | 44.0%  |        |
| Zone D | Irrigated | 24,673      | 58.0%  | 0      | -      | 0      | -      | 24,673 | 64.4%  |
|        | Rainfed   | 17,777      | 42.0%  | 42.5   | 100.0% | 3,821  | 100.0% | 13,532 | 35.6%  |
|        | Sub-total | 42,450      | 100.0% | 42.5   | 100.0% | 3,821  | 100.0% | 38,205 | 100.0% |
|        |           | 100.0%      |        | 1.0%   |        | 9.0%   |        | 90.0%  |        |
| Total  | Irrigated | 49,978      | 46.0%  | 3,449  | 13.3%  | 6,115  | 28.5%  | 40,414 | 65.9%  |
|        | Rainfed   | 58,650      | 54.0%  | 22,468 | 86.7%  | 15,361 | 71.5%  | 20,821 | 34.1%  |
|        | Total     | 108,628     | 100.0% | 25,917 | 100.0% | 21,476 | 100.0% | 61,235 | 100.0% |
|        |           | 100.0%      |        | 23.9%  |        | 19.8%  |        | 56.4%  |        |

Source : Estimation based on farm survey results and AST data.

Remarks ; F0: highland, flood depth less than 0.3 m, F1 : medium highland, flood depth between 0.3 to 0.9 m, F2&F3 :medium lowland and lowland, flood depth between more than 0.9 m.



### E.3.3 Cropping Systems and Cultural Practices

#### E.3.3.1 Crop Management

##### (1) Cropping season

There are three cropping seasons in a year: two summer rainy seasons (kharif-1 from March to June, kharif-2 from July to October), and the winter dry season (rabi from November to February). More than 80% of annual rainfall (about 3,200 mm in Noakhali to 2,300 in Hajiganj) is distributed in summer seasons, and crop production can be constrained by waterlogged soils, flooding, low solar radiation, high humidity and infestation by pests and diseases. Paddy is the predominant crop in summer seasons, and two rice crops are generally grown, aus in kharif-1 (pre-monsoon) followed by aman in kharif-2 (monsoon). Deepwater rice requires longer growth period throughout kharif-1 and 2. Such upland crops as pulses, oilseeds and vegetables are grown in a limited area as is Jute in the Kharif 1 season.

Rabi is characterized by scanty rainfall, lower temperatures, high solar radiation, low humidity, and lower infection of insect pests and diseases. A wide range of crops are grown in this season. They include both tropical and temperate crops such as boro paddy, wheat, potatoes, mustard, chillies and winter vegetables. Although low soil moisture content may limit cropped area and yield, irrigation is highly effective to increase production. Lower temperature in the winter season allows preparation of nursery boro paddy in December, transplant in January to February and harvest in April to May.

##### (2) Crop sequences

A wide range of cropping patterns can be found in the area, and farmers apply various modifications of pattern to their lands. Among the various factors to determine the cropping patterns, inundation depth of flood as well as availability of irrigation water are the dominant factors. Cropping sequence is therefore broadly categorized according to land type of flood phase and availability of irrigation water to minimize flood damage and maximize advantages of irrigation.

Supposing that the land is not affected by flood and poor drainage in two rainy seasons, a basic cropping pattern under irrigated condition can be assumed to be HYV boro in winter season followed by HYV aman in summer season, and other basic cropping pattern under rainfed condition can be attempted as HYV aus and HYV aman in the summer season followed by upland short term crops in winter dry season. In a practical manner, however, flood depth in various land type and irrigation brings broad variations of those basic cropping patterns to avoid serious damage caused by flood and drought which cannot be predicted before planting.

##### (a) F0 (highland, flood depth less than 30 cm)

On the high ground where floods rarely affect the aus and aman crops, basic cropping pattern can be slightly modified. HYV boro in rabi season and HYV aman in summer season is the typical cropping pattern under irrigated condition. Under rainfed condition, aus paddy is followed by aman paddy, and then followed by rabi upland crops using residual soil moisture. Local varieties are generally dominant

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in aus and aman paddy. Typical rabi crops are mainly wheat, pulses, oilseeds (mustard), potato, winter vegetables (tomato, cauliflower, cabbage, brinjal) and spices (chilli, onion). Wheat and potatoes may be irrigated.

(b) F1 (medium highland, flood depth 30 to 90 cm)

In the medium highland, HYV aman can be grown in the area where flood depth is less at about 60 to 70 cm. As flood depth increases, longer strawed local varieties become more popular. In areas where flooding starts later, kharif-1 crops such as aus and jute are grown, while where floods come earlier, kharif-1 crops are not cultivated, but broadcast aman is sown one month before floods start. Farmers attempt to assure the maximum production through keeping limited areas under mixed broadcast aman and broadcast aus. Irrigation is practiced for HYV boro and rabi crops are cultivated under rainfed condition.

(c) F2 & F3 (medium lowland and lowland, flood depth more than 90 cm)

Flooding usually comes early, and this situation may not permit a normal aus crop, resulting in broadcast deepwater aman as the main kharif paddy. Under irrigated condition, HYV boro is widely grown. However, rabi or wheat followed by broadcast aman is dominant in the rainfed land. In the area where flooding is deeper and longlasting, crop is limited to only a single crop of HYV boro or local boro.

Accordingly, the present cropping pattern is estimated as the schematic patterns which express approximate duration and areal distribution by land types, and is shown in Fig. E.3.1.

### E.3.3.2 Crop Area and Intensities

Crop area and intensity in the Noakhali North project area may change in the wide range due to fluctuation of rainfall, flood and expansion of irrigation. Crop area is mainly estimated on the basis of the farmer survey with supplement of the secondary data such as BBS, DAE and AST. Crop area by land type in each planning zone is shown in Tables E.3.14 to E.3.18 and summarized below.

(1) Crop Area

Total cropped area is estimated at approximately 180,500 ha or 166% cropping intensity in the whole project area. Rice is the main crop, which accounts 162,900 ha or 90% of the total cropped area, followed by 16,800 ha (9%) of rabi crop, 900 ha (below 1%) of jute and summer vegetables. The main rabi crop is pulses (58% of rabi crop area), spices (21%) and oilseeds (mostly mustard, 14%) also potato, wheat and vegetables are planted in small areas. The cropped area by land type is shown below:





Figure E.3.1  
Schematic Cropping Pattern under Present Condition [P]  
in the Noakhali North Project Area

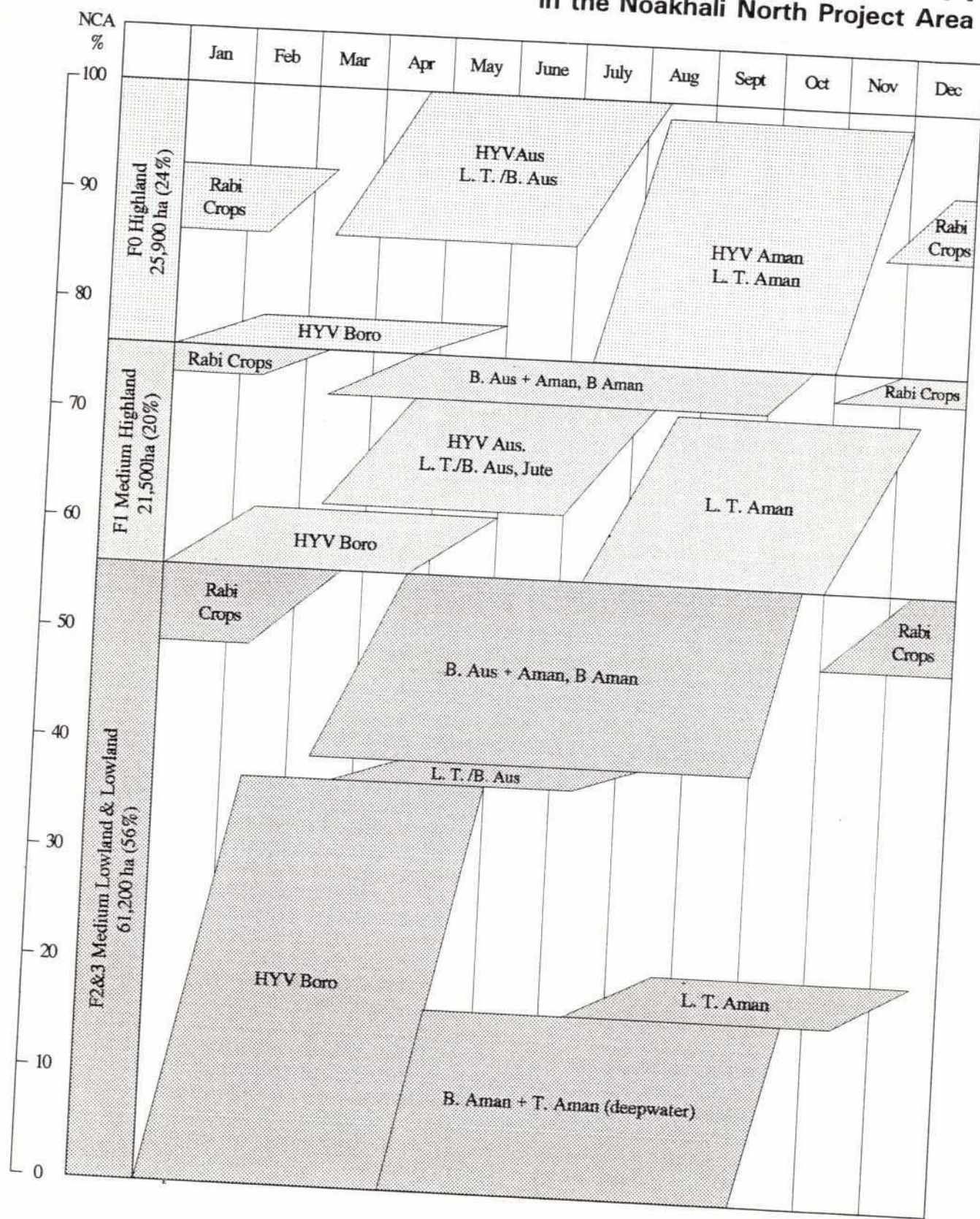




TABLE E.3.11

## Crop Area

(Unit:ha)

| Crop             | Total   |       | F0     |       | F1     |       | F2 & F3 |       |
|------------------|---------|-------|--------|-------|--------|-------|---------|-------|
|                  | Area    | Ratio | Area   | Ratio | Area   | Ratio | Area    | Ratio |
| Rice             | 162,929 | 90%   | 42,521 | 87%   | 37,172 | 91%   | 83,211  | 91%   |
| Jute             | 795     | 1%    | -      | -     | 753    | 2%    | 42      | 0%    |
| Rabi crops       | 16,777  | 9%    | 6,297  | 13%   | 2,752  | 7%    | 7,727   | 8%    |
| Summer Vegetable | 43      | 0%    | 43     | 0%    | -      | -     | -       | -     |
| Total            | 180,544 | 100%  | 48,861 | 100%  | 40,677 | 100%  | 91,010  | 100%  |

Area under rice by land type is shown in Table E.3.12. Rice crops consists of 23% of aus, 46% of aman and 31% of boro. 44% of rice crop is high yielding varieties (HYV), particularly in boro rice. Area under aus and aman decreases on lower land due to higher flood depth.

TABLE E.3.12

## Rice Crop Area

(Unit:ha)

| Crop          | Total   |       | F0     |       | F1     |       | F2 & F3 |       |
|---------------|---------|-------|--------|-------|--------|-------|---------|-------|
|               | Area    | Ratio | Area   | Ratio | Area   | Ratio | Area    | Ratio |
| HYV aus       | 14,364  | 9%    | 7,031  | 17%   | 4,342  | 12%   | 2,991   | 3%    |
| B./L.T. aus   | 23,939  | 14%   | 7,505  | 18%   | 9,551  | 26%   | 7,883   | 8%    |
| HYV aman      | 6,224   | 4%    | 5,969  | 14%   | 255    | 1%    | 0       | 0     |
| B./L.T. aman  | 68,429  | 42%   | 18,567 | 44%   | 16,909 | 45%   | 32,953  | 40%   |
| HYV boro      | 49,978  | 31%   | 3,449  | 8%    | 6,115  | 16%   | 40,414  | 49%   |
| Total of rice | 162,934 | 100%  | 42,521 | 100%  | 37,172 | 100%  | 83,241  | 100%  |
| NCA           | 108,628 |       | 25,917 |       | 21,476 |       | 61,235  |       |

(2) Cropping Intensity

Cropping intensity is estimated at 166% in the whole area, ranging from the lowest intensity of 157% in Zone B to the highest of 184% in Zone A. These wide variations are mainly explained by the difference in composition of flood phase and extent of irrigation.

TABLE E.3.13

Cropping Intensity

Unit:ha

| Planning<br>Zone | Total  |       | F0     |       | F1     |       | F2&F3  |       |
|------------------|--------|-------|--------|-------|--------|-------|--------|-------|
|                  | NCA    | C. I. | NCA    | C. I. | NCA    | C. I. | NCA    | C. I. |
| Zone A           | 22,956 | 184%  | 20,890 | 185%  | 2,066  | 171%  | -      | -     |
| Zone B           | 21,115 | 157%  | 845    | 160%  | 6,968  | 199%  | 13,302 | 135%  |
| Zone C           | 22,107 | 173%  | 3,758  | 209%  | 8,622  | 193%  | 9,727  | 140%  |
| Zone D           | 42,450 | 158%  | 425    | 210%  | 3,821  | 174%  | 38,205 | 155%  |
| Total Area       | 108628 | 166%  | 25,917 | 189%  | 21,476 | 189%  | 61,235 | 149%  |

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TABLE E.3.14

Crop Area of the Noakhali North Project Area (Whole Area)

| (Unit:ha)                            |         |       |        |       |        |       |         |       |
|--------------------------------------|---------|-------|--------|-------|--------|-------|---------|-------|
| Land Type by Flood Phase             |         |       |        |       |        |       |         |       |
| Crop                                 | Total   |       | F0     |       | F1     |       | F2 & F3 |       |
|                                      | Area    | Ratio | Area   | Ratio | Area   | Ratio | Area    | Ratio |
| Area by Flood Phase                  | 108,628 | 100%  | 25,917 | 24%   | 21,476 | 20%   | 61,235  | 56%   |
| Cropped Area & Intensity             | 180,548 | 166%  | 48,861 | 189%  | 40,677 | 189%  | 91,010  | 149%  |
| <u>Kharif-1 Season</u>               |         |       |        |       |        |       |         |       |
| B. Aus:LV                            | 11,782  | 11%   | 7,080  | 7%    | 3,836  | 4%    | 866     | 1%    |
| B. Aus:HYV                           | 4,984   | 5%    | 4,772  | 4%    | 212    | 0%    | -       | -     |
| T. Aus :LV                           | 3,909   | 4%    | 425    | 0%    | 3,062  | 3%    | 422     | 0%    |
| T. Aus :HYV                          | 4,788   | 4%    | 2,259  | 2%    | 2,529  | 2%    | -       | -     |
| B. Aus + Aman                        | 8,248   | 8%    | -      | -     | 2,653  | 2%    | 5,595   | 5%    |
| B. Aman:LV                           | 15,481  | 14%   | -      | -     | 1,660  | 2%    | 13,821  | 13%   |
| Jute                                 | 795     | 1%    | -      | -     | 753    | 1%    | 42      | 0%    |
| Summer Vegetables                    | 43      | 0%    | 43     | 0%    | -      | -     | 0       | 0%    |
| Sub-total                            | 50,030  | 46%   | 14,579 | 13%   | 14,705 | 14%   | 20,746  | 19%   |
| <u>Kharif-2 Season</u>               |         |       |        |       |        |       |         |       |
| T. Aus :HYV                          | 4,592   | 4%    | -      | -     | 1,601  | 1%    | 2,991   | 3%    |
| B. Aman:LV                           | 13,093  | 12%   | -      | -     | 0      | 0%    | 13,093  | 12%   |
| T. Aman:LV (deep water)              | 4,835   | 4%    | -      | -     | 0      | 0%    | 4,835   | 4%    |
| T. Aman:LV                           | 35,020  | 32%   | 18,567 | 17%   | 15,249 | 14%   | 1,204   | 1%    |
| T. Aman:HYV                          | 6,224   | 6%    | 5,969  | 5%    | 255    | 0%    | -       | -     |
| Sub-total                            | 63,764  | 59%   | 24,536 | 23%   | 17,105 | 16%   | 22,123  | 20%   |
| <u>Rabi Season</u>                   |         |       |        |       |        |       |         |       |
| Boro:LV                              | -       | -     | 0      | 0%    | -      | -     | 0       | 0%    |
| Boro:LIV                             | -       | -     | 0      | 0%    | -      | -     | 0       | 0%    |
| Boro:HYV                             | 49,978  | 46%   | 3,449  | 3%    | 6,115  | 6%    | 40,414  | 37%   |
| Wheat                                | 159     | 0%    | 159    | 0%    | -      | -     | 0       | 0%    |
| Pulses                               | 9,676   | 9%    | 2,254  | 2%    | 901    | 1%    | 6,521   | 6%    |
| Oilseeds                             | 2,323   | 2%    | 1,010  | 1%    | 318    | 0%    | 995     | 1%    |
| Potato                               | 312     | 0%    | 312    | 0%    | -      | -     | 0       | 0%    |
| Winter Vegetables                    | 794     | 1%    | 794    | 1%    | -      | -     | 0       | 0%    |
| Spices                               | 3,512   | 3%    | 1,768  | 2%    | 1,533  | 1%    | 211     | 0%    |
| Sub-total                            | 66,754  | 61%   | 9,746  | 9%    | 8,867  | 8%    | 48,141  | 44%   |
| <u>Summary of Rice Cropped Area</u>  |         |       |        |       |        |       |         |       |
| HYV aus                              | 14,364  | 9%    | 7,031  | 17%   | 4,342  | 12%   | 2,991   | 3%    |
| B./L.T. aus                          | 23,939  | 14%   | 7,505  | 18%   | 9,551  | 26%   | 6,883   | 8%    |
| HYV aman                             | 6,224   | 4%    | 5,969  | 14%   | 255    | 1%    | -       | -     |
| B./L.T. aman                         | 68,429  | 42%   | 18,567 | 44%   | 16,909 | 45%   | 32,953  | 49%   |
| HYV boro                             | 49,978  | 31%   | 3,449  | 8%    | 6,115  | 16%   | 40,414  | 0     |
| L.T. boro                            | -       | -     | -      | -     | -      | -     | -       | -     |
| Sub-total of rice                    | 162,934 | 100%  | 42,521 | 100%  | 37,170 | 100%  | 83,241  | 100%  |
| <u>Summary of Total Cropped Area</u> |         |       |        |       |        |       |         |       |
| Rice                                 | 162,934 | 90%   | 42,521 | 87%   | 37,172 | 91%   | 83,241  | 91%   |
| Jute                                 | 795     | 0%    | -      | -     | 753    | 2%    | 42      | 0%    |
| Rabi crops                           | 16,776  | 9%    | 6,297  | 13%   | 2,752  | 7%    | 7,727   | 8%    |
| Summer Vegetable                     | 43      | 0%    | 43     | 0%    | -      | -     | -       | -     |
| Total                                | 180,548 | 100%  | 48,861 | 100%  | 40,677 | 100%  | 91,010  | 100%  |



TABLE E.3.15

## Crop Area in Planning Zone A of the Noakhali North Project Area

(Unit:ha)

| Crop                                 | Land Type by Flood Phase |       |        |       |       |       |         |       |
|--------------------------------------|--------------------------|-------|--------|-------|-------|-------|---------|-------|
|                                      | Total                    |       | F0     |       | F1    |       | F2 & F3 |       |
|                                      | Area                     | Ratio | Area   | Ratio | Area  | Ratio | Area    | Ratio |
| Area by Flood Phase                  | 22,956                   | 100 % | 20,890 | 91 %  | 2,066 | 9 %   | 0       | -     |
| Cropped Area & Intensity             | 42,285                   | 184 % | 38,750 | 185 % | 3,535 | 171 % | 0       | -     |
| <u>Kharif-1 Season</u>               |                          |       |        |       |       |       |         |       |
| B. Aus:LV                            | 6,014                    | 26 %  | 6,014  | 26 %  | -     | -     | -       | -     |
| B. Aus:HYV                           | 3,627                    | 16 %  | 3,627  | 16 %  | -     | -     | -       | -     |
| T. Aus :LV                           | 298                      | 1 %   | 298    | 1 %   | -     | -     | -       | -     |
| T. Aus :HYV                          | 689                      | 3 %   | 689    | 3 %   | -     | -     | -       | -     |
| B. Aus + Aman                        | 161                      | 1 %   | -      | -     | 161   | 1 %   | -       | -     |
| B. Aman:LV                           | 643                      | 3 %   | -      | -     | 643   | 3 %   | -       | -     |
| Jute                                 | 46                       | 0 %   | -      | -     | 46    | 0 %   | -       | -     |
| Summer Vegetables                    | -                        | -     | -      | -     | -     | -     | -       | -     |
| Sub-total                            | 11,478                   | 50 %  | 10,628 | 46 %  | 850   | 4 %   | 0       | -     |
| <u>Kharif-2 Season</u>               |                          |       |        |       |       |       |         |       |
| T. Aus :HYV                          | -                        | -     | -      | -     | -     | -     | -       | -     |
| B. Aman:LV                           | -                        | -     | -      | -     | -     | -     | -       | -     |
| T. Aman:LV (deep water)              | -                        | -     | -      | -     | -     | -     | -       | -     |
| T. Aman:LV                           | 16,505                   | 72 %  | 15,472 | 67 %  | 1,033 | 5 %   | -       | -     |
| T. Aman:HYV                          | 4,270                    | 19 %  | 4,270  | 19 %  | -     | -     | -       | -     |
| Sub-total                            | 20,775                   | 91 %  | 19,742 | 86 %  | 1,033 | 5 %   | 0       | -     |
| <u>Rabi Season</u>                   |                          |       |        |       |       |       |         |       |
| Boro:LV                              | -                        | -     | -      | -     | -     | -     | -       | -     |
| Boro:LIV                             | -                        | -     | -      | -     | -     | -     | -       | -     |
| Boro:HYV                             | 3,925                    | 17 %  | 3,007  | 13 %  | 918   | 4 %   | -       | -     |
| Wheat                                | 115                      | 1 %   | 115    | 1 %   | -     | -     | -       | -     |
| Pulses                               | 2,502                    | 11 %  | 2,043  | 9 %   | 459   | 2 %   | -       | -     |
| Oilseeds                             | 1,285                    | 6 %   | 1,010  | 4 %   | 275   | 1 %   | -       | -     |
| Potato                               | 184                      | 1 %   | 184    | 1 %   | -     | -     | -       | -     |
| Winter Vegetables                    | 253                      | 1 %   | 253    | 1 %   | -     | -     | -       | -     |
| Spices                               | 1,768                    | 8 %   | 1,768  | 8 %   | -     | -     | -       | -     |
| Sub-total                            | 10,032                   | 44 %  | 8,380  | 37 %  | 1,652 | 7 %   | 0       | -     |
| <u>Summary of Rice Cropped Area</u>  |                          |       |        |       |       |       |         |       |
| HYV aus                              | 4,316                    | 12 %  | 4,316  | 13 %  | -     | -     | -       | -     |
| B./L.T. aus                          | 6,473                    | 19 %  | 6,312  | 19 %  | 161   | 6 %   | -       | -     |
| HYV aman                             | 4,270                    | 12 %  | 4,270  | 13 %  | -     | -     | -       | -     |
| B./L.T. aman                         | 17,148                   | 47 %  | 15,472 | 46 %  | 1,676 | 61 %  | -       | -     |
| HYV boro                             | 3,925                    | 11 %  | 3,007  | 9 %   | 918   | 33 %  | -       | -     |
| L.T. boro                            | -                        | -     | -      | -     | -     | -     | -       | -     |
| Sub-total of rice                    | 36,132                   | 100 % | 33,377 | 100 % | 2,755 | 100 % | -       | -     |
| <u>Summary of Total Cropped Area</u> |                          |       |        |       |       |       |         |       |
| Rice                                 | 36,132                   | 85 %  | 33,377 | 86 %  | 2,755 | 78 %  | 0       | -     |
| Jute                                 | 46                       | 0 %   | -      | -     | 46    | 1 %   | -       | -     |
| Rabi crops                           | 6,107                    | 14 %  | 5,373  | 14 %  | 734   | 21 %  | -       | -     |
| Summer Vegetable                     | -                        | -     | -      | -     | -     | -     | -       | -     |
| Total                                | 42,285                   | 100 % | 38,750 | 100 % | 3,535 | 100 % | 0       | -     |

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TABLE 3.16

## Crop Area in Planning Zone B of the Noakhali North Project Area

(Unit:ha)

| Crop                                 | Land Type by Flood Phase |       |            |       |            |       |                 |       |
|--------------------------------------|--------------------------|-------|------------|-------|------------|-------|-----------------|-------|
|                                      | Total<br>Area            | Ratio | F0<br>Area | Ratio | F1<br>Area | Ratio | F2 & F3<br>Area | Ratio |
| Area by Flood Phase                  | 21,115                   | 100%  | 845        | 4%    | 6,968      | 33%   | 13,302          | 63%   |
| Cropped Area & Intensity             | 33,151                   | 157%  | 1,351      | 160%  | 13,852     | 199%  | 17,948          | 135%  |
| <u>Kharif-1 Season</u>               |                          |       |            |       |            |       |                 |       |
| B. Aus:LV                            | 1,077                    | 5%    | 211        | 1%    | -          | -     | 866             | 4%    |
| B. Aus:HYV                           | 106                      | 1%    | 106        | 1%    | -          | -     | -               | -     |
| T. Aus :LV                           | 2,534                    | 12%   | -          | -     | 2,112      | 10%   | 422             | 2%    |
| T. Aus :HYV                          | 2,175                    | 10%   | -          | -     | 2,175      | 10%   | -               | -     |
| B. Aus + Aman                        | 3,400                    | 16%   | -          | -     | -          | -     | 3,400           | 16%   |
| B. Aman:LV                           | -                        | -     | -          | -     | -          | -     | -               | -     |
| Jute                                 | 42                       | 0%    | -          | -     | -          | -     | 42              | 0%    |
| Summer Vegetables                    | 21                       | 0%    | 21         | 0%    | -          | -     | -               | -     |
| Sub-total                            | 9,355                    | 44%   | 338        | 2%    | 4,287      | 20%   | 4,730           | 22%   |
| <u>Kharif-2 Season</u>               |                          |       |            |       |            |       |                 |       |
| T. Aus :HYV                          | 486                      | 2%    | -          | -     | -          | -     | 486             | 2%    |
| B. Aman:LV                           | 1,330                    | 6%    | -          | -     | -          | -     | 1,330           | 6%    |
| T. Aman:LV (deep water)              | 63                       | 0%    | -          | -     | -          | -     | 63              | 0%    |
| T. Aman:LV                           | 8,172                    | 39%   | -          | -     | 6,968      | 33%   | 1,204           | 6%    |
| T. Aman:HYV                          | 633                      | 3%    | 633        | 3%    | -          | -     | -               | -     |
| Sub-total                            | 10,684                   | 51%   | 633        | 3%    | 6,968      | 33%   | 3,083           | 15%   |
| <u>Rabi Season</u>                   |                          |       |            |       |            |       |                 |       |
| Boro:LV                              | -                        | -     | -          | -     | -          | -     | -               | -     |
| Boro:LIV                             | -                        | -     | -          | -     | -          | -     | -               | -     |
| Boro:HYV                             | 10,769                   | 51%   | -          | -     | 2,323      | 11%   | 8,446           | 40%   |
| Wheat                                | -                        | -     | -          | -     | -          | -     | -               | -     |
| Pulses                               | 1,689                    | 8%    | 211        | 1%    | -          | -     | 1,478           | 7%    |
| Oilseeds                             | 21                       | 0%    | -          | -     | 21         | 0%    | -               | -     |
| Potato                               | 42                       | 0%    | 42         | 0%    | -          | -     | -               | -     |
| Winter Vegetables                    | 127                      | 1%    | 127        | 1%    | -          | -     | -               | -     |
| Spices                               | 465                      | 2%    | -          | -     | 253        | 1%    | 211             | 1%    |
| Sub-total                            | 13,112                   | 62%   | 380        | 2%    | 2,597      | 12%   | 10,135          | 48%   |
| <u>Summary of Rice Cropped Area</u>  |                          |       |            |       |            |       |                 |       |
| HYV aus                              | 2,767                    | 9%    | 106        | 11%   | 2,175      | 16%   | 486             | 3%    |
| B./L.T. aus                          | 7,011                    | 23%   | 211        | 22%   | 2,112      | 16%   | 4,688           | 29%   |
| HYV aman                             | 633                      | 2%    | 633        | 67%   | -          | -     | -               | -     |
| B./L.T. aman                         | 9,565                    | 31%   | -          | -     | 6,968      | 51%   | 2,597           | 16%   |
| HYV boro                             | 10,769                   | 35%   | -          | -     | 2,323      | 17%   | 8,446           | 52%   |
| L.T. boro                            | -                        | -     | -          | -     | -          | -     | -               | -     |
| Sub-total of rice                    | 30,745                   | 100%  | 950        | 100%  | 13,578     | 100%  | 16,217          | 100%  |
| <u>Summary of Total Cropped Area</u> |                          |       |            |       |            |       |                 |       |
| Rice                                 | 30,745                   | 93%   | 950        | 70%   | 13,578     | 98%   | 16,217          | 90%   |
| Jute                                 | 42                       | 0%    | -          | -     | -          | -     | 42              | 0%    |
| Rabi crops                           | 2,343                    | 7%    | 380        | 28%   | 274        | 2%    | 1,689           | 9%    |
| Summer Vegetable                     | 21                       | 0%    | 21         | 2%    | -          | -     | -               | -     |
| Total                                | 33,151                   | 100%  | 1,351      | 100%  | 13,852     | 100%  | 17,948          | 100%  |

TABLE E.3.17

## Crop Area in Planning Zone C of the Noakhali North Project Area

(Unit:ha)

| Crop                                 | Land Type by Flood Phase |       |       |       |        |       |         |       |
|--------------------------------------|--------------------------|-------|-------|-------|--------|-------|---------|-------|
|                                      | Total                    |       | F0    |       | F1     |       | F2 & F3 |       |
|                                      | Area                     | Ratio | Area  | Ratio | Area   | Ratio | Area    | Ratio |
| Area by Flood Phase                  | 22,107                   | 100%  | 3,758 | 17%   | 8,622  | 39%   | 9,727   | 44%   |
| Cropped Area & Intensity             | 38,158                   | 173%  | 7,869 | 209%  | 16,626 | 193%  | 13,663  | 140%  |
| <u>Kharif-1 Season</u>               |                          |       |       |       |        |       |         |       |
| B. Aus:LV                            | 3,205                    | 15%   | 685   | 3%    | 2,520  | 11%   | -       | -     |
| B. Aus:HYV                           | 1,039                    | 5%    | 1,039 | 5%    | -      | -     | -       | -     |
| T. Aus :LV                           | 951                      | 4%    | -     | -     | 951    | 4%    | -       | -     |
| T. Aus :HYV                          | 1,924                    | 9%    | 1,570 | 7%    | 354    | 2%    | -       | -     |
| B. Aus + Aman                        | 1,504                    | 7%    | -     | -     | 752    | 3%    | 752     | 3%    |
| B. Aman:LV                           | 2,697                    | 12%   | -     | -     | 1,017  | 5%    | 1,680   | 8%    |
| Jute                                 | 155                      | 1%    | -     | -     | 155    | 1%    | -       | -     |
| Summer Vegetables                    | 22                       | 0%    | 22    | 0%    | -      | -     | -       | -     |
| Sub-total                            | 11,497                   | 52%   | 3,316 | 15%   | 5,749  | 26%   | 2,432   | 11%   |
| <u>Kharif-2 Season</u>               |                          |       |       |       |        |       |         |       |
| T. Aus :HYV                          | 752                      | 3%    | -     | -     | 752    | 3%    | -       | -     |
| B. Aman:LV                           | 1,150                    | 5%    | -     | -     | -      | -     | 1,150   | 5%    |
| T. Aman:LV (deep water)              | 951                      | 4%    | -     | -     | -      | -     | 951     | 4%    |
| T. Aman:LV                           | 9,197                    | 42%   | 3,095 | 14%   | 6,102  | 28%   | -       | -     |
| T. Aman:HYV                          | 641                      | 3%    | 641   | 3%    | -      | -     | -       | -     |
| Sub-total                            | 12,691                   | 57%   | 3,736 | 17%   | 6,854  | 31%   | 2,101   | 10%   |
| <u>Rabi Season</u>                   |                          |       |       |       |        |       |         |       |
| Boro:LV                              | -                        | -     | -     | -     | -      | -     | -       | -     |
| Boro:LIV                             | -                        | -     | -     | -     | -      | -     | -       | -     |
| Boro:HYV                             | 10,611                   | 48%   | 442   | 2%    | 2,874  | 13%   | 7,295   | 33%   |
| Wheat                                | 44                       | 0%    | 44    | 0%    | -      | -     | -       | -     |
| Pulses                               | 1,282                    | 6%    | -     | -     | 442    | 2%    | 840     | 4%    |
| Oilseeds                             | 1,017                    | 5%    | -     | -     | 22     | 0%    | 995     | 5%    |
| Potato                               | 44                       | 0%    | 44    | 0%    | -      | -     | -       | -     |
| Winter Vegetables                    | 287                      | 1%    | 287   | 1%    | -      | -     | -       | -     |
| Spices                               | 685                      | 3%    | -     | -     | 685    | 3%    | -       | -     |
| Sub-total                            | 13,970                   | 63%   | 817   | 4%    | 4,023  | 18%   | 9,130   | 41%   |
| <u>Summary of Rice Cropped Area</u>  |                          |       |       |       |        |       |         |       |
| HYV aus                              | 3,715                    | 11%   | 2,609 | 35%   | 1,106  | 7%    | -       | -     |
| B./L.T. aus                          | 5,660                    | 16%   | 685   | 9%    | 4,223  | 28%   | 752     | 6%    |
| HYV aman                             | 641                      | 2%    | 641   | 9%    | -      | -     | -       | -     |
| B./L.T. aman                         | 13,995                   | 40%   | 3,095 | 41%   | 7,119  | 46%   | 3,781   | 32%   |
| HYV boro                             | 10,611                   | 31%   | 442   | 6%    | 2,874  | 19%   | 7,295   | 62%   |
| L.T. boro                            | -                        | -     | -     | -     | -      | -     | -       | -     |
| Sub-total of rice                    | 34,622                   | 100%  | 7,472 | 100%  | 15,322 | 100%  | 11,828  | 100%  |
| <u>Summary of Total Cropped Area</u> |                          |       |       |       |        |       |         |       |
| Rice                                 | 34,622                   | 91%   | 7,472 | 95%   | 15,322 | 92%   | 11,828  | 87%   |
| Jute                                 | 155                      | 0%    | -     | -     | 155    | 1%    | -       | -     |
| Rabi crops                           | 3,359                    | 9%    | 375   | 5%    | 1,149  | 7%    | 1,835   | 13%   |
| Summer Vegetable                     | 22                       | 0%    | 22    | 0%    | -      | -     | -       | -     |
| Total                                | 38,158                   | 100%  | 7,869 | 100%  | 16,626 | 100%  | 13,663  | 100%  |



TABLE E.3.18

## Crop Area in Planning Zone D of the Noakhali North Project Area

(Unit:ha)

| Crop                                 | Land Type by Flood Phase |       |      |       |       |       |         |       |
|--------------------------------------|--------------------------|-------|------|-------|-------|-------|---------|-------|
|                                      | Total                    |       | F0   |       | F1    |       | F2 & F3 |       |
|                                      | Area                     | Ratio | Area | Ratio | Area  | Ratio | Area    | Ratio |
| Area by Flood Phase                  | 42,450                   | 100%  | 425  | 1%    | 3,820 | 9%    | 38,205  | 90%   |
| Cropped Area & Intensity             | 66,954                   | 158%  | 891  | 210%  | 6,664 | 174%  | 59,399  | 155%  |
| <u>Kharif-1 Season</u>               |                          |       |      |       |       |       |         |       |
| B. Aus:LV                            | 1,486                    | 4%    | 170  | 0%    | 1,316 | 3%    | -       | -     |
| B. Aus:HYV                           | 212                      | 1%    | -    | -     | 212   | 1%    | -       | -     |
| T. Aus :LV                           | 127                      | 0%    | 127  | 0%    | -     | -     | -       | -     |
| T. Aus :HYV                          | -                        | -     | -    | -     | -     | -     | -       | -     |
| B. Aus + Aman                        | 3,183                    | 8%    | -    | -     | 1,740 | 4%    | 1,443   | 3%    |
| B. Aman:LV                           | 12,141                   | 29%   | -    | -     | -     | -     | 12,141  | 29%   |
| Jute                                 | 552                      | 1%    | -    | -     | 552   | 1%    | -       | -     |
| Summer Vegetables                    | -                        | -     | -    | -     | -     | -     | -       | -     |
| Sub-total                            | 17,701                   | 42%   | 297  | 1%    | 3,820 | 9%    | 13,584  | 32%   |
| <u>Kharif-2 Season</u>               |                          |       |      |       |       |       |         |       |
| T. Aus :HYV                          | 3,354                    | 8%    | -    | -     | 849   | 2%    | 2,505   | 6%    |
| B. Aman:LV                           | 10,613                   | 25%   | -    | -     | -     | -     | 10,613  | 25%   |
| T. Aman:LV (deep water)              | 3,821                    | 9%    | -    | -     | -     | -     | 3,821   | 9%    |
| T. Aman:LV                           | 1,146                    | 3%    | -    | -     | 1,146 | 3%    | -       | -     |
| T. Aman:HYV                          | 680                      | 2%    | 425  | 1%    | 255   | 1%    | -       | -     |
| Sub-total                            | 19,614                   | 46%   | 425  | 1%    | 2,250 | 5%    | 16,939  | 40%   |
| <u>Rabi Season</u>                   |                          |       |      |       |       |       |         |       |
| Boro:LV                              | -                        | -     | -    | -     | -     | -     | -       | -     |
| Boro:LIV                             | -                        | -     | -    | -     | -     | -     | -       | -     |
| Boro:HYV                             | 24,673                   | 58%   | -    | -     | -     | -     | 24,673  | 58%   |
| Wheat                                | -                        | -     | -    | -     | -     | -     | -       | -     |
| Pulses                               | 4,203                    | 10%   | -    | -     | -     | -     | 4,203   | 10%   |
| Oilseeds                             | -                        | -     | -    | -     | -     | -     | -       | -     |
| Potato                               | 42                       | 0%    | 42   | 0%    | -     | -     | -       | -     |
| Winter Vegetables                    | 127                      | 0%    | 127  | 0%    | -     | -     | -       | -     |
| Spices                               | 594                      | 1%    | -    | -     | 594   | 1%    | -       | -     |
| Sub-total                            | 29,639                   | 70%   | 169  | 0%    | 594   | 1%    | 28,876  | 68%   |
| <u>Summary of Rice Cropped Area</u>  |                          |       |      |       |       |       |         |       |
| HYV aus                              | 3,566                    | 6%    | -    | -     | 1,061 | 19%   | 2,505   | 4%    |
| B./L.T. aus                          | 4,796                    | 8%    | 297  | 41%   | 3,056 | 55%   | 1,443   | 3%    |
| HYV aman                             | 680                      | 1%    | 425  | 59%   | 255   | 5%    | -       | -     |
| B./L.T. aman                         | 27,721                   | 45%   | -    | -     | 1,146 | 21%   | 26,575  | 48%   |
| HYV boro                             | 24,673                   | 40%   | -    | -     | -     | -     | 24,673  | 45%   |
| L.T. boro                            | -                        | -     | -    | -     | -     | -     | -       | -     |
| Sub-total of rice                    | 61,436                   | 100%  | 722  | 100%  | 5,518 | 100%  | 55,196  | 100%  |
| <u>Summary of Total Cropped Area</u> |                          |       |      |       |       |       |         |       |
| Rice                                 | 61,436                   | 92%   | 722  | 81%   | 5,518 | 83%   | 55,196  | 93%   |
| Jute                                 | 552                      | 1%    | -    | -     | 552   | 8%    | -       | -     |
| Rabi crops                           | 4,966                    | 7%    | 169  | 19%   | 594   | 9%    | 4,203   | 7%    |
| Summer Vegetable                     | -                        | -     | -    | -     | -     | -     | -       | -     |
| Total                                | 66,954                   | 100%  | 891  | 100%  | 6,664 | 100%  | 59,399  | 100%  |

### E.3.4 Crop Husbandry and Input Use

#### E.3.4.1 General Description of Farming Practices

Most farmers use part of the harvest as seed for the following seasons. Some farmers buy seed from their neighbours or in local markets. This way of self-multiplication without roguing, purification and cleaning causes deterioration of genetic characteristics and mixture of varieties, particularly for HYV. High seed rate is reduced by low germination rate due to improper storage. Vegetable seeds are usually purchased in markets.

Land preparation is made through ploughing, laddering, puddling and leveling using local equipments mainly drawn by a pair of draft animals. Several ploughings to a depth of 7.5 to 15 cm are followed by laddering to break the clods. After soils are saturated by irrigation water or rainfall, paddy fields are puddled and leveled. In part of the area, power tillers are operated to rotavate and puddle the paddy field.

Most aus, mixed aus/aman and deepwater aman rice are sown by broadcasting in lower land. Jute and upland crops are also sown directly. Some spices such chilli and onion are transplanted in some area. Some pulses and oilseeds are grown as a relay crop by broadcasting seed into a standing aman crop 15 to 20 days before harvesting. Paddy seedlings are raised in dry nurseries for aus and aman to prevent flood damage and to keep for a longer period. Nurseries for boro are usually established in wet condition. Generally 2 to 3 seedling per hill are transplanted, however, more seedlings are used for delayed transplanting in the kharif season to compensate for low tillering.

Urea, MP, TSP, zinc, gypsum are applied as basal at the time of land preparation. During crop growth, top dressing of urea is given three to four times when available. Farmers also apply animal manure as basal by mixing surface soils in land preparation. To prevent pests and diseases, use of agro-chemicals is increasing. Varietal rotation and integrated pest management is not conducted. Weeding by raking with a wooden harrow is common practice in aus and jute at early stage. Hand-weeding is widely done for major crops.

All crops are harvested by hand. Aus crop is harvested in deep water using boats for transportation. Threshing through beating by hand or trampling by cattle are common practices. Treadle thresher is used in some areas. Threshed rice is dried on the road, mat or drying floor, and then winnowed before storing or selling. Farmers face problems in drying aus crops during the monsoon season.

#### E.3.4.2 Input Use

Typical rates of input use of fertilizers, pesticides and seeds for major crops are shown in Table E.3.19. These are estimated on the basis of the farmer and case study surveys carried out in this study. Input use shows a wide variation depending on crops, varieties, irrigation condition, farming practices as well as supply condition, and availability of operation fund. Generally, broadcast rice crops of aus, aman and mixed aus/aman show the lower rates of inputs than transplanted rice. Input dosage for local varieties is smaller than the HYV rice. Crops under irrigated condition are cultivated using more inputs than crops grown in rainfed land.

Although most work is carried out by the farmer and his family, it is necessary to hire labour in for operation of transplanting, weeding and harvesting.

Draught animals play an important role for farming practices such as land preparation, weed control, transportation and threshing. About 35% of the farmers own draught animals, however, 58% hire animals due to shortage of draught power. Also 33% of the farmers are using power tiller at present. It is considered that the farmers using power tillers will increase to help solve shortage of draught power.

Use of chemical fertilizers has increased over recent years, and they are applied to most crops at present, according to farmer surveys. Traditionally animal manure was the main fertilizer, however, availability of manure is limited due to the decreasing number of animals and intensive use of cow dung as fuel.

Irrigation is primarily used for boro production, and wheat, potatoes and vegetables in the rabi season are also irrigated. In the kharif season, supplemental irrigation is provided to HYV aus and aman. LLP is the dominant mode of irrigation.



TABLE E.3.19

## Unit Input Quantity and Unit Yield of the Noakhali North Project Area

| Crop                   | Farm<br>Labour<br>man-days | Draft<br>Animals<br>pair-days | Seed<br>kg | Fertilizer |           |          | Animal<br>Manure<br>kg | Agro-<br>chemi-<br>cals<br>kg | Products       |             |
|------------------------|----------------------------|-------------------------------|------------|------------|-----------|----------|------------------------|-------------------------------|----------------|-------------|
|                        |                            |                               |            | Urea<br>kg | TSP<br>kg | MP<br>kg |                        |                               | main<br>ton/ha | by<br>to/ha |
| B. aus, LV             | 138                        | 45                            | 85         | 60         | 30        | 0        | 1,000                  | 0.2                           | 1.60           | 3.20        |
| B. aus, HYV            | 144                        | 45                            | 85         | 80         | 40        | 0        | 1,000                  | 0.25                          | 2.40           | 2.40        |
| T. aus, LV             | 154                        | 47                            | 30         | 80         | 40        | 0        | 1,000                  | 0.25                          | 2.40           | 4.80        |
| T. aus, HYV, irrig.    | 178                        | 47                            | 30         | 140        | 50        | 10       | 1,000                  | 0.50                          | 3.25           | 3.25        |
| T. aus, HYV, unirrig.  | 174                        | 47                            | 30         | 140        | 50        | 10       | 1,000                  | 0.50                          | 2.85           | 2.85        |
| Mixed aus/aman         | 165                        | 44                            | 83         | 80         | 40        | 0        | 0                      | 0.13                          | 2.30           | 2.30        |
| B. aman, deepwater     | 108                        | 44                            | 83         | 40         | 0         | 0        | 0                      | 0.13                          | 1.60           | 1.60        |
| T. aman, deepwater     | 130                        | 40                            | 44         | 90         | 0         | 0        | 0                      | 0.13                          | 2.00           | 2.00        |
| T. aman, LV            | 141                        | 40                            | 44         | 80         | 40        | 29       | 0                      | 0.25                          | 2.10           | 4.20        |
| T. aman, HYV, irrig.   | 170                        | 43                            | 30         | 120        | 80        | 25       | 700                    | 1.16                          | 3.75           | 3.75        |
| T. aman, HYV, unirrig. | 166                        | 43                            | 30         | 120        | 80        | 25       | 700                    | 1.16                          | 3.55           | 3.55        |
| Boro, LV               | 118                        | 25                            | 40         | 120        | 0         | 0        | 0                      | 0.00                          | 2.80           | 5.60        |
| Boro, HYV, irrig.      | 210                        | 43                            | 30         | 170        | 140       | 30       | 1,000                  | 1.00                          | 5.00           | 5.00        |
| Wheat, irrig.          | 127                        | 45                            | 130        | 115        | 80        | 30       | 0                      | 0.30                          | 2.25           | 2.25        |
| Wheat, unirrig.        | 102                        | 45                            | 130        | 80         | 50        | 24       | 0                      | 0.30                          | 1.80           | 1.80        |
| Potato, irrig.         | 194                        | 44                            | 1,000      | 277        | 290       | 102      | 1,500                  | 3.00                          | 15.00          | 0.00        |
| Potato, unirrig.       | 175                        | 44                            | 1,000      | 277        | 290       | 102      | 1,500                  | 2.00                          | 10.00          | 0.00        |
| Jute                   | 215                        | 45                            | 9          | 89         | 67        | 9        | 2,000                  | 0.00                          | 1.90           | 3.80        |
| Pulses, average        | 50                         | 30                            | 31         | 0          | 0         | 0        | 0                      | 0.00                          | 0.68           | 0.68        |
| Mustard                | 58                         | 37                            | 10         | 192        | 144       | 40       | 750                    | 0.40                          | 0.75           | 0.75        |
| Spices (chilli)        | 157                        | 30                            | 1          | 100        | 180       | 90       | 2,500                  | 0.00                          | 4.00           | 0.00        |
| Vegetables (Brinjal)   | 270                        | 44                            | 1          | 100        | 60        | 40       | 2,500                  | 0.30                          | 8.00           | 0.00        |

Source: Consultants' Farmers and Case Study Surveys.

### E.3.4.3 Management of Major Crops

#### (a) Aus Paddy

Broadcast aus, mainly local varieties with HYV in small portion, is sown in dry land at the onset of the monsoon season in medium to highland. Application of inputs is at limited level due to low yield. Inadequate rainfall in March and April causes delayed seeding, and then increases the risk of damage by flood. Other form of broadcast aus is sown at this time on slightly lower land mixed with the seed of deepwater aman. The whole crop is harvested when aus matures before the land is deeply flooded. The aman then grows from ratoon to give harvest in November to December. In this way, the farmers try to insure their harvest by spreading the risk of flood.

Transplanted aus is also grown on higher and better drained ground in a limited area, and it may sometimes be irrigated at the initial stage.

#### (b) Aman Paddy

Broadcast deepwater aman is sown in March and April in a small area, mainly on lower ground. Transplanted aman is sown after harvesting a boro crop or when the flood starts. On the higher ground, aman is transplanted with supplemental irrigation supply.

#### (c) Boro Paddy

High irrigation rate of farm land in the area enables high yielding varieties predominant in boro paddy on the medium to highland in the dry and winter season. Nursery is established in December to January, and seedlings are transplanted in January to February. Early floods in April to May and low temperature in December to January are the major problems of boro paddy.

#### (d) Jute

There are two species of *C. capsularis* (desi or mesta) and *C. olitorius* (tossa) grown in the area. *C. capsularis* is dominant due to resistance to deep water. Jute is sown in early kharif (March to May) on lower ground and harvested in June to August when flowering starts. The plants are cut and left in the field until leaves are shed. The plants are then bundled and submerged in water for 2 to 3 weeks for retting. After the plants rot, fibres and sticks are separated. The fibres are washed and dried before sale. The jute sticks are also dried before use as fuel or fencing. Farming practices require much labour force for thinning, weeding, harvesting and post-harvest.

(e) Rabi Crops

Wheat, Potatoes and pulses are main upland crops in the rabi season. Wheat is cropped from November to December and harvested in February to March by utilizing residual soil moisture. Potatoes are planted late October to November and harvested in February and March. Pulses generally include several kind of legumes, and khesari, masur (lentil) and mash kali (black gram) is common in the area. Spices and vegetables are grown in limited areas. Chillies are on important spice in the area. Winter vegetables are supplied to Dhaka. Summer vegetables including beans, brinjal and squash are also grown in the area, however, their area is limited to the higher ground.

### E.3.5 Crop Yields

Although some crop yield fluctuates year by year in a wide range, statistical data show general trends of increasing yield. This may be mainly depending on progress of irrigation equipment supply, extension of HYV, expansion of supply of fertilizers with improved farming practices, flood control and drainage improvement. The current level of average crop yields is estimated on the basis of the farmer survey with adjustment by other secondary data available as shown in Table E.3.19.

Total anual cereal production is about 491 thousand ton of rice and wheat which accounts 212 kg of per capita production which is more than per capita consumption (Table E.3.20). Per capita production of grains are relatively low in Zone B.

TABLE E.3.20

#### Present Agricultural Production

(Unit:ton)

| Crop              | Planning Zone |         |         |         | Total   |
|-------------------|---------------|---------|---------|---------|---------|
|                   | A             | B       | C       | D       |         |
| Rice              | 91,900        | 100,700 | 104,400 | 193,600 | 490,600 |
| Wheat             | 200           | -       | 100     | -       | 300     |
| Total of Grains   | 92,100        | 100,700 | 104,500 | 193,600 | 490,900 |
| per capita*       | 321 kg        | 151 kg  | 203 kg  | 229 kg  | 212 kg  |
| Pulses            | 1,700         | 1,100   | 800     | 2,900   | 6,500   |
| Oilseeds          | 1,000         | 0       | 800     | -       | 1,800   |
| Potato            | 1,800         | 400     | 400     | 400     | 3,000   |
| Winter Vegetables | 2,000         | 1,000   | 2,300   | 1,000   | 6,300   |
| Spices            | 7,100         | 1,900   | 2,700   | 2,400   | 14,100  |
| Jute              | 100           | 100     | 300     | 1,000   | 1,500   |
| Summer Vegetable  | -             | 200     | 200     | -       | 400     |

Remark; \*: Population in 1993 is estimated at 286,600 for Zone A, 666,100 for Zone B, 513,900 for Zone C, 845,500 for Zone D, and 2,312,100 for the whole area.



### E.3.6 Agricultural Support Services

#### E.3.6.1 Agricultural Extension and Research

Agricultural extension services provided by the Department of Agricultural Extension (DAE) of Ministry of Agriculture. Under DAE, Deputy Director of Agriculture controls extension activities in district level with support of Special Matter Specialists in crop production, pest control and training. Thana Agriculture Officer (TAO) manages extension work at Thana level, and is supported by a Subject Matter Officer, Assistant Agricultural Extension Officer and Junior Agriculture Officer. Block Supervisors are grass roots extension agents under the TAO. Thana is divided into Blocks which cover 900 to 1,000 households. Blocks are sub-divided into 8 Sub-Blocks in which 10 contact farmers are designated. Block Supervisors provide farmers with extension services through contact farmers under T&V system. This system is now being improved under the Agricultural Support Services Programme assisted by World Bank, ODA and USAID in minor irrigation operation and on-farm water management.

There is a Regional Research Station of the Bangladesh Rice Research Institute at Comilla, for research into rice, providing comprehensive applied research. Most inputs are available in the local markets in and around the area. Supply channels of farm inputs and irrigation equipment such as fertilizer, chemicals, LLP and shallow tubewells have been changed to private sector from Bangladesh Agricultural Development Corporation (BADC) by the national policy of privatization or reduction of subsidy on farm inputs. Certified seeds of major crops are currently supplied by BADC.

#### E.3.6.2 Agricultural Credit

##### a) Credit Requirements and Sources

Farmers may require short-term credit to finance agricultural inputs such as fertiliser, seeds, irrigation charges, and hired bullocks and labour. They may also need longer term loans to cover purchase of livestock, irrigation equipment or power tillers. All households may also need credit to meet social obligations (such as weddings) and emergencies, while some, particularly the poorest group, may also need credit to buy food and other necessities during periods of hardship prior to harvests, or if they suffer losses in floods or other disasters.

Credit is available from institutional sources (banks, cooperatives and NGOs) and from a range of informal sources such as money-lenders, input suppliers, relatives and neighbours. The surveys conducted for the Noakhali North feasibility study suggest that farmers make surprisingly little use of credit, funding most of their requirements from crop sales or other sources of income (see Table E.3.21). although this low level of borrowing suggests that farmers have little need for credit, it could also mean that they are unable to get credit, either because it is not available, or because they are unable to get access.

TABLE E.3.21

Sources of Finance for Farm Inputs

|                                    | <u>% of farmers</u> |
|------------------------------------|---------------------|
| Retrained funds (previous crops)   | 43.5                |
| Retained funds (other enterprises) | 34.0                |
| Asset sales                        | 12.0                |
| Relatives, friends                 | 2.5                 |
| Commercial banks                   | 5.0                 |
| Input suppliers                    | 0.5                 |
| Money lenders                      | 2.5                 |
| <b>Total</b>                       | <b>100.0</b>        |

b) Bank Lending

The main source of institutional credit for agriculture are the Sonali, Rupali, Janata, Krishi and Agrani Banks whose lending activities are coordinated in what is known as the lead bank system. In Noakhali, the lead bank is the Rupali which is responsible for disseminating information on leading targets to the other banks as well as collecting data on performance.

Two sorts of loans are made, one to finance crop production which is short term, usually six months which is a long term loan and another to finance the purchase of irrigation equipment which has a term of 9 years. Total amounts lent by the lead bank system are presented in Table E.3.22 where it can be seen that relative to the number of farmers in the seven thanas represented the sums are minute.

Nationally bank lending to agriculture nearly halved between 1987/88 and 1990/91, after a rapid rise between 1985/86 to 1987/88 when it nearly doubled. Figures presented in Table E.3.22 do not show any increase however.

Rapid expansion in agricultural credit and rural bank branches overstretched the management capacities of the banks involved. Loan recovery rates are low, and a study into agricultural credit<sup>1</sup> estimated that the recovery rate declined from 44% in 1980 to 19% in 1989. As a result of poor recovery many borrowers have become defaulters and are disqualified from future borrowing.

<sup>1</sup> Institutional Credit in Bangladesh Agriculture, R. Nerin USAID 1988.

TABLE E.3.22

## Bank Lending to Agriculture (Selected Thanas)

|                   | Crop Production Loans(Tk 000) |                |                |                    | Loans for the Purchase of Irrigation Equipment |                |                |                    |
|-------------------|-------------------------------|----------------|----------------|--------------------|--|----------------|----------------|--------------------|
|                   | Target                        | Amount<br>Lent | No of<br>Loans | Av Size<br>of Loan | Target   | Amount<br>Lent | No of<br>Loans | Av Size<br>of Loan |
| 1989/90           |                               |                |                |                    |  |                |                |                    |
| Noakhali Sadar    | 16906                         | 14880          | 9860           | 1.5                | 275  | 150            | 2              | 75.0               |
| Senbag            | 11060                         | 9990           | 5560           | 1.8                | 700  | 175            | 2              | 87.5               |
| Begumganj         | 18271                         | 16320          | 9446           | 1.7                | 1400   | 275            | 2              | 137.5              |
| Chatkhil          | 9010                          | 6390           | 3332           | 1.9                | 400  | 35             | 1              | 35.0               |
| Shahrasti         | 10615                         | 4925           | 1042           | 4.7                |  | 157            | 3              | 52.3               |
| Hajiganj          | 11219                         | 4887           | 1202           | 4.1                |  | 271            | 4              | 67.8               |
| Faridganj         | 17673                         | 11118          | 2655           | 4.2                | 0  | 0              | 0              | 0.0                |
|                   | 94754                         | 68510          | 33097          | 2.1                | 2775   | 1063           | 14             | 75.9               |
| 1990/91           |                               |                |                |                    |  |                |                |                    |
| Noakhali Sadar    | 18040                         | 16550          | 11240          | 1.5                | 600  | 50             | 1              | 50.0               |
| Senbag            | 10950                         | 8290           | 4782           | 1.7                | 1250   | 290            | 3              | 96.7               |
| Begumganj         | 19670                         | 17480          | 10082          | 1.7                | 1800   | 278            | 2              | 139.0              |
| Chatkhil          | 9150                          | 5550           | 2352           | 2.4                | 700  | 25             | 1              | 25.0               |
| Shahrasti         | 11173                         | 4439           | 1062           | 4.2                |  | 4964           | 28             | 177.3              |
| Hajiganj          | 10143                         | 4247           | 974            | 4.4                |  | 1013           | 6              | 168.8              |
| Faridganj         | 17633                         | 9111           | 2214           | 4.1                | 0  | 0              | 0              | 0.0                |
|                   | 96759                         | 65667          | 32706          | 2.0                | 4350   | 6620           | 41             | 161.5              |
| 1991/92           |                               |                |                |                    |  |                |                |                    |
| Noakhali Sadar    | 17660                         | 14530          | 8624           | 1.7                | 190  | 29             | 1              | 29.0               |
| Senbag            | 10110                         | 8460           | 4894           | 1.7                | 476  | 190            | 3              | 63.3               |
| Begumganj         | 19200                         | 16930          | 9520           | 1.8                | 560  | 338            | 2              | 169.0              |
| Chatkhil          | 9080                          | 7730           | 5380           | 1.4                | 170  | 31             | 1              | 31.0               |
| Shahrasti         | 14220                         | 12688          | 2624           | 4.8                |  | 2019           | 13             | 155.3              |
| Hajiganj          | 8740                          | 3516           | 286            | 12.3               |  | 2022           | 12             | 168.5              |
| Faridganj         | 15265                         | 11351          | 1722           | 6.6                | 0  | 0              | 0              | 0.0                |
|                   | 94275                         | 75205          | 33050          |                    | 1396   | 4629           | 32             | 144.7              |
| Average per Thana | 11908                         | 8724           | 4119           | 2                  |  | 513            | 4              | 142                |



Poor performance of the banking sector is attributed to a weak management capability and inadequate operating procedures, together with a shortage of qualified staff. The bank has been subject to political and social pressures to increase lending volumes, and lack field level contact with farmers. Where they have attempted to utilise local organisations to approve loan applications, the vetting procedures involved have resulted in access to credit becoming a form of political patronage.

Although banks may insist on the mortgaging of land as collateral (many small farmers find it difficult and expensive to establish proper title to their land), enforcement of such recovery instruments is almost non-existent: there are no records of banks obtaining possession and selling land belonging to a defaulter.

The government, through the Financial Sector Reform Project (FSRP), is attempting to improve the banks' accounting, management information systems, and credit delivery/recovery systems. This project, which is supported by the World Bank and USAID, started in 1990. It is attempting to classify outstanding loans and get the NCBs to make provision against profits for loans of dubious quality, and generally improve loan discipline. However these attempts suffered a setback in 1991 when a general waiver was announced on agricultural loans under Tk 5,00. many borrowers with larger loans have ceased repayments in the hope that their loans will be forgiven. Despite this write off, overdue agricultural loans still amount to over Tk 32,000 million.

Greater attention to the viability of lending, with branch officers being made more accountable appears to be making banks extremely reluctant to lend in all sectors of the economy. although they have a large supply of liquid funds, and continue to allocate large amounts to the agricultural sector, only a small proportion of this is actually disbursed.

#### c) Lending by NGOs for Agriculture

a number of NGOs have credit programmes which have been strikingly successful in reaching the rural poor, and in achieving rates of loan repayment in excess of 95 percent. Although the volume of this lending is large (Grammeen bank disbursed Tk. 6.2 million in 1990), the bulk of it is for non-agricultural purposes, as most NGOs exclude people owning over 0.2 ha of land, so its effect on agricultural productivity is limited.

A number of NGOs have developed specific irrigation credit programmes. BRAC and Proshika support the formation groups of landless people who buy and operate irrigation pumps and generate income via water sales. although these programmes have been successful their scope is limited to landless groups. Grammen Bank has had a less happy experience in taking over responsibility for over 1000 DTW formerly operated by a government project in the north-west.

## CHAPTER E.4

### FUTURE DEVELOPMENT PROPOSALS

#### E.4.1 Strategy for Development

The basic objective of any proposed development in the area is one of economic improvements. This encompasses the maximisation of the net present value of aggregate consumption benefits and employment generation. With current Government policy of attempting to reduce public sector expenditure, the encouragement of investment by the private sector is important. An other factors which must be accounted for in the formulation of interventions are the need to avoid as far as possible improving the flooding regime in a benefited area at the expense of significantly worsening flooding in another. Experience elsewhere in Bangladesh has demonstrated that the likely outcome of such a strategy is that the disbenefited populace may well take matters into their own hands and cut the embankment, with obvious and disastrous consequences. Apart from increasing the risks of failure (though public cuts), the social impacts of such interventions are divisive and clearly inequitable. Where minor adverse affects are precipitated, mitigation measures to redress the balance must be considered.

In the case of the Noakhali North Project, project interventions to improve flooding regimes are not expected to make any areas, either inside or outside the project area any worse. Indeed it is expected that drainage will be improved in some places outside the project area sufficiently to reduce flood plain fish catches.

In general interventions are evaluated on the basis of current levels of Government activity in agricultural support through the Extension Service (DAE) and the Bangladesh Agriculture Development Corporation (BADC) which is responsible for seed production and distribution. Programmes to assist and develop these services are inevitably country-wide and cannot easily incorporate local programmes which are only likely to be funded by a project for a short time. The inference is that improvements in agricultural support services are expected to benefit areas both inside and outside the project area equally and that it is unrealistic to anticipate substantially increased extension inputs on which future yield increases can be justified.

The project area is not well endowed with exploitable groundwater resources. In many areas the groundwater is saline; in others there is a sweet water layer which could in theory be skimmed off the saline water beneath but this would require very skilled installation and operation of the wells. It is not foreseen that this will become a practical proposition in the near future. A small number of DTW may be developed but will have a small impact (see Annex C). Thus future groundwater development, especially in Zones A, B and C is not expected to have an impact on project cropping patterns.

#### E.4.2 Development Proposals

##### E.4.2.1 Background

The Noakhali North Drainage and Irrigation Project was identified during the preparation of the South East Regional Study's Draft Regional Plan.

The project was approved for feasibility study in August 1992 by GOB and by the donor and executing agencies.

The project may generally be described as a sub-regional drainage project with substantial additional irrigation benefits.

The nature of the drainage element of the project precludes drawing well defined boundaries to the likely benefited areas but the primary areas of influence are defined on Figure E.4.1 This shows the northern boundary as the Dakatia river. The eastern boundary as the Dakatia to Begumganj railway and then east to the divide between the Little Feni and Noakhali khal basins. The southern boundary largely follows the old coastal embankment but in the west the line has been taken to include the extreme northern parts of polder 58/2A. The western boundary comprises the Meghna left embankments in the southern parts and the Chandpur Irrigation Project eastern embankment up to the Dakatia river.

#### **E.4.2.2 Project Objectives**

The principle problems of the area are long duration congested drainage in the monsoon period and extreme shortages of water for irrigation in the dry season.

These drainage problems steadily worsened during the 1960's and early 1970's as new lands accreted to the south and fresh water for irrigation has always been a problem for much of the area.

The project objectives are, as far as possible to improve drainage conditions in the severely flooded Begumganj depression and its surrounding areas and at the same time to maximise the irrigation area which can be supplied from the Lower Meghna by gravity supplies.

#### **E.4.2.3 Project Concept**

The project seeks to build on the works carried out in the early 1970's under the Noakhali Comprehensive Drainage Scheme by deepening and widening the main khal system and also by enlarging the Rahamatkhali regulator.

The design of the scheme is based on a completely free flowing "natural" drainage system so that there is minimal opportunity for obstruction and mal-operation.

At the same time care has been taken to ensure that improvements in drainage are balanced so that no area suffers higher water levels as a result of improvements elsewhere.

The scheme is also designed to overcome a number of subsidiary problems in the area. Improved drainage is principally achieved through lower water levels. These lower levels are achieved by flattening water gradients. In turn this tends to produce lower channel velocities which reduces bank erosion.



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In addition to the improvement of the main khal system further improvements are proposed in the larger secondary khals to provide a more comprehensive drainage system which spreads the drainage benefits wider within the project area.

Also the proposed scheme will allow Meghna water into the khal system during the dry season on a massively increased scale to provide greatly increased areas of irrigation. Once again the absence of intermediate structures in the system is an essential element in the design. The khal system will operate as a tidal and night storage system allowing maximum water entry and the widest distribution possible.

This dual free drainage and irrigation system removes the need for the construction of cross-dams in the main system. Indeed construction of such dams would merely impede both drainage and irrigation and thus no benefits would accrue to the builder.

#### **E.4.2.4 Scheme Operation**

The entire scheme will operate automatically without power requirements and only minimal operation activities are required on a seasonal basis at the regulator. This seasonal operation would be arranged to provide free access for fish during April and May up until rising Meghna levels require the closure of the drainage flaps. The design of the flaps has also been arranged to provide better access for fish at all times when the gates are open.

### **E.4.3 Future Agricultural Development**

#### **E.4.3.1 Methodology**

Present cropping patterns are based on information obtained from the farmer survey in which the crops grown during one year were recorded for each plot operated by the farmer respondents. Future cropping patterns depend on assumptions relating to future irrigation development in the dry season and project interventions which improve flooding regimes in the wet season.

#### **The Use of the Mike II Hydrodynamic Model**

The evaluation of flood mitigation projects in Bangladesh has for some time been based on classifications of flood depth known as flood phases. These are categorised as follows:

|       |   |                             |
|-------|---|-----------------------------|
| F0    | - | flood depths of 0.3 M       |
| F1    | - | flood depths of 0.3 - 0.9 M |
| F2    | - | flood depths of 0.9 - 1.8 M |
| F3+F4 | - | flood depths of 1.8 M       |

This classification system has been in use for some time and is retained by the Regional Plan for broad level planning purposes, as both crop statistics and cropping distributions have been developed by the Master Planning Organisation for flood phases by planning unit which enable flood mitigation programmes to be evaluated on the basis of changes in flood phasing which result from proposed interventions. A drawback of the present classification, for other than broad level planning is that it relates neither to the duration of flooding nor to the



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frequency with which the inundation occurs. Thus, for example, an intervention which reduced the duration of flooding while at the same time had little impact on its peak depth might well enable an aman crop to be transplanted on the receding flood for which no benefit under the depth of flooding rules can be claimed. As a result FPCO have produced (but not yet officially published) a new set of guidelines which specify the maximum depths of flooding which various types of rice can withstand throughout their life cycle. These are presented in Table E.4.1.

The rules have been incorporated within the processing package of the Mike II hydro-dynamic model as follows:

- depths of flooding tolerances, as presented in Table E.4.1 are transformed into histograms of maximum allowable flooding depths by 10 day periods to accord with the 10 day analysis used by the model for a range of planting/sowing dates (See Annex B, Modelling).
- in each decad (with three decads per calendar month) crop failure occurs on the fourth day on which the level exceeds the critical value. Hence each decad should be represented as a maximum of a four day minimum level, starting by looking three days backwards into the previous decad. Water levels were analysed at each representative river level node in terms of four day exceedances over the whole year for the 25 year run which enabled them to be expressed in terms of probabilities.
- water levels are translated into areas of land flooded to various depths by comparison with area elevation curves for each minute square (311 hectares) which are calculated by reference to the land level data base. The data base itself is simply a large number of entries of topographic heights for each minute square which is based on the 4 inch to one mile BWDB Water Development Maps compiled in the 1960's, where each point represents approximately three hectares.
- areas on which crops can be safely grown are calculated by application of FPCO submergence rules over a range of conditions, which include the extreme, average and one in 3, 4, 5, 8 and 10 wet years.

The output from the model is consequently a list of the percentages of an area on which crops can be safely grown at specified probability levels. For many crops the list is academic as the area actually grown is determined by other factor such as access to irrigation. The model only produces areas on which crops can be theoretically grown, other things being equal. In addition, because the model is unable to represent flash floods satisfactorily, it cannot be used to assess either their impact or frequency. Fortunately this is not of major importance in the Noakhali North area.

### Cropping Patterns

Cropping patterns are determined by a large variety of factors but among the more important are :

- access to irrigation in the dry season which to a very large extent decides whether or not a boro crop is grown.



TABLE E.4.1

Submergence Tolerance Range of Rice at Different Growth Stages

| <u>CROP</u> | <u>GROWTH STAGE</u> | <u>SUBMERGENCE RANGE</u> | <u>PERIOD</u>       |
|-------------|---------------------|--------------------------|---------------------|
| HYV Boro    | Transplanting       | 10 - 20 cm               | January - February  |
|             | Vegetative          | 30 - 50 cm               | March               |
|             | Reproductive        | 20 - 30 cm               | April               |
|             | Maturity            | 30 cm                    | May                 |
| B Aus       | Seeding             | Field Capacity           | March - April       |
|             | Vegetative          | 50 - 70 cm               | May                 |
|             | Reproductive        | 30 - 50 cm               | June                |
|             | Maturity            | 50 cm                    | July                |
| HYV Aus     | Transplanting       | 10 - 20 cm               | March - April       |
|             | Vegetative          | 30 - 50 cm               | May - June          |
|             | Reproductive        | 20 - 30 cm               | July                |
|             | Maturity            | 30 cm                    | August              |
| LT Aus      | Transplanting       | 20 - 30 cm               | March - April       |
|             | Vegetative          | 50 - 70 cm               | May - June          |
|             | Reproductive        | 30 - 50 cm               | July                |
|             | Maturity            | 50 cm                    | August              |
| LT Aman     | Transplanting       | 20 - 30 cm               | July - September    |
|             | Vegetative          | 50 - 70 cm               | September - October |
|             | Reproductive        | 30 - 50 cm               | November            |
|             | Maturity            | 50 cm                    | November - December |
| HYV Aman    | Transplanting       | 10 - 20 cm               | July - August       |
|             | Vegetative          | 30 - 50 cm               | September - October |
|             | Reproductive        | 20 - 30 cm               | October - November  |
|             | Maturity            | 30 cm                    | November - December |
| DWR         | Seeding             | Field Capacity           | March - April       |
|             | Transplanting       | 30 - 50 cm               | April - May         |
|             | Vegetative          | 50 - 400 cm*             | June - September    |
|             | Reproductive        | 50 - 90 cm               | October - November  |
|             | Maturity            | Field Capacity           | November - December |

\* Rise in water level has to be gradual so that the plants can keep pace.

- the flooding regime in the monsoon season which determines whether or not a farmer can grow transplanted high yielding aman, transplanted local varieties of aman, deep water aman or nothing.
- attitudes to risk which are generally determined by farmers' expectations of likely costs and returns but which are also a function of farmers' ability to bear losses should they arise. These are not clear cut for some farmers are in a position where crop failure is not much worse an outcome than not planting because either strategy is catastrophic in terms of providing food for their families. Other farmers are in a more fortunate position where they are able to grow sufficient food for consumption with relatively low risk crops and are unwilling to gamble this security on the chance of either higher returns or the possibility of jeopardising their holdings through incurring losses. Larger farmers are generally in a position to decide for themselves what strategy to adopt although evidence from the farmer survey suggests that the very large farmers tend to farm at lower intensities than either medium or small farmers, and invariably have other sources of income to rely on.

Changes in cropping patterns which can be anticipated are expected to result from both increased access to irrigation and changed flooding regimes. Increased irrigation invariably results in increased boro cultivation, as the crop produces high yields, good returns and is generally perceived as being less risky than most other crops. Any increase in boro cultivation has widespread implications for many other crops in both the rabi and aus seasons. Some short duration crops such as pulses and oilseeds may precede a boro crop but only if they are planted on the receding flood. Wheat, potatoes and most winter vegetables are not generally harvested in time for a boro crop to be planted. The same is true of aus, mixed aus aman and jute crops which are seeded in March, April (and May to some extent) and thus compete with the boro crop which is harvested in (late) April, May and early June. Transplanted aus and deepwater aman crops may follow boro but require an early boro harvest as well as a fast turnaround in land preparation and transplanting. Consequently this sequence of crops cannot be expected to cover a very high proportion of the area. Broadcast deep water aman is another crop which can follow boro but it is more safely sowed in March or April when it is unlikely to be damaged by severe early rains (the crop cannot be broadcast into standing water) and has plenty of time to establish itself well enough to elongate with the arrival of floods (a period of about two months). Thus broadcasting aman after the middle of April becomes increasingly more risky the later it is sowed, and consequently has been restricted in the development of cropping patterns to a maximum of ten per cent of the area in question.

Transplanted aman crops (HYV varieties are transplanted in July and August, local varieties in July, August and September) may follow aus crops but it is more common for them to follow the boro crop as this gives farmers plenty of time to prepare the land and tend their nurseries. In general transplanted aman crops do not compete for land with any other seasonal crops except deepwater varieties which are by definition generally grown elsewhere.

They do conflict with early sown rabi crops as transplanted aman is generally harvested in November and December, by which time the residual moisture has evaporated sufficiently to hinder germination of unirrigated rabi crops. Some farmers overcome this problem by broadcasting seed into the standing aman crop, but in general it may be concluded that increased areas of transplanted aman crops are likely to restrict the ability of farmers to grow crops in the time between the harvest of aman and the transplanting of boro.

From the above it can be seen that future cropping patterns will be mainly determined by assumptions concerning both access to irrigation and projected flooding regimes.

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All existing irrigation within the project area comes under the category of minor irrigation; that is to say that there are no schemes involving major pump stations and/or extensive gravity distribution. Estimates of irrigated area in each of the project area zones have been based on the following sources:

- the farmer survey which asked whether (and how) a crop grown on each of the farmers' plots is irrigated or not
- data collected by the Bangladesh - Canada Agricultural Sector Team (AST) on numbers of and areas commanded by minor irrigation equipment by extension block and Thana.
- Thana statistics from the Development of Agricultural Extension (DAE) and the Bangladesh Bureau of Statistics on irrigation areas and modes.

A discussion of the development trends of all modes of minor irrigation based upon AST and other data sources is presented in Chapter 2 of the Main Report.

In general it was found that the farmer survey produced higher irrigation coverage than either AST figures or DAE/BBS statistics.

A comparison of results is presented in Table E.4.2 below. At first sight the discrepancy between AST data and the farmer survey look large in all Zones other than Zone A. However an adjustment, based on the pump operator survey which showed that about 20-25% of pumps are used to irrigate two separate areas and consequently increases the area irrigated, brings the two figures closer together. As it is not known whether the AST data or the farmer survey are correct, a mid-way point between the two was calculated. As the mid way point is close (ie within 3000 hectares) to the adjusted AST data, there is reasonable justification for accepting these numbers. They are obviously very important because they determine how much benefit the project can claim in the future by increasing water availability in the khals. In this respect it is fortunate that the best correlation between AST data and the farmer survey occurs in Zone A as this is where the greatest increase in water availability in the "future with" is expected. Table E.4.2 presents estimates of increased irrigation in the "future with" project where it can be seen that an additional area of 18,509 ha will be irrigated of which 9,626 are in Zone A, 2,621 ha are in Zone B, 4,230 ha are in Zone C and 2,034 ha in Zone D.

Overall the area irrigated across the whole project is forecast to increase from 46% to 63%. Only minor increases in groundwater exploitation are anticipated for the reasons given in Chapter Two of the Main Report and Annex C (Groundwater).

### **Flooding Regimes**

Output from the hydro-dynamic model post processing runs provides maximum areas of crops which can be safely grown at various levels of risk in both the "present" and "future with" project situations. While these give a useful indication of the potential improvements which an intervention might achieve, it is necessary to establish how well the model predicts present cropped areas of transplanted aman before it can be used to predict future cropped areas. As far as the model results are concerned transplanted amans are the key crops (both HYV and LT) because these are directly controlled by the flooding regime and can be increased with little adverse affect on other crops other than the deepwater amans which they might replace.



TABLE E.4.2

## Irrigation Areas in Noakhali North Project Area

| Irrigation Areas                   | Zone A | Zone B | Zone C | Zone D | Total  |
|------------------------------------|--------|--------|--------|--------|--------|
| Gross area                         | 29332  | 35553  | 32769  | 63160  | 160814 |
| Net cultivable area                | 22956  | 21115  | 22107  | 42450  | 108628 |
| Farmer survey:                     |        |        |        |        |        |
| Irrigated area %                   | 18.70  | 64.14  | 56.20  | 72.50  |        |
| area                               | 4293   | 13543  | 12424  | 30776  | 61036  |
| AST data %                         | 15.49  | 37.86  | 39.80  | 44.16  |        |
| area                               | 3557   | 7994   | 8799   | 18744  | 39094  |
| AST adjusted area                  | 4268   | 9488   | 11265  | 24366  | 49387  |
| Average %                          | 17.10  | 51.00  | 48.00  | 58.10  | 46.01  |
| area                               | 3925   | 10769  | 10611  | 24673  | 49978  |
| Areas to be irrigated by project   | 12129  | 3615   | 8944   | 3157   | 27845  |
| Areas already irrigated (1991)     | 2384   | 947    | 4490   | 1070   | 8891   |
| (1992)                             | 2503   | 994    | 4715   | 1124   | 9336   |
| Additional areas                   | 9626   | 2621   | 4230   | 2034   | 18509  |
| Irrigation coverage (with project) | 13551  | 13389  | 14841  | 26707  | 68487  |
| %                                  | 0.59   | 0.63   | 0.67   | 0.63   | 0.63   |

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A comparison between the model output and farmer survey predictions for T Aman areas is presented in Tables E.4.3, E.4.4 and E.4.5, where it can be seen that both the model and MPO predict far higher areas of HYV aman than the survey, whilst simultaneously under predicting the areas of LT aman. If the total of all T aman is considered (for a 1 in 5 wet year) both MPO and the model predict accurate results in Zone A whereas MPO is more accurate in Zone B and the model more accurate in Zones C and D. Where the output of the model for a 1 in 2 wet year is included, it can be seen that the model's predictions for LT aman are much closer to the survey's estimates. In other words, whilst farmers are not prepared to risk growing HYV aman it seems clear that either they are happy to take far greater chances with LT aman or that restrictions within the model, especially those which limit transplanting to maximum depths of 20 cms are too severe in a 1 in 5 wet year simulation. Certainly one strategy available to farmers is to grow taller seedlings for planting into deeper water, up to 25 to 30 cms for example, even though it is to be expected that the transplant will take longer to establish itself and is vulnerable to any increased water levels for about three weeks. What is clear from the comparison is that the model is more conservative than MPO in its predictions of total T. aman, whilst at the same time allowing larger areas of HYV aman (15% more). Unfortunately it is also clear that both the model and MPO overpredict the HYV aman area actually grown at present.

As the reasons for farmers underplanting HYV aman were not known a special additional 30 farmer survey was organised in Zone A (4 mouzas) and C (2 mouzas) to try and find out. The results are not clear cut but the following views emerged.

- every farmer interviewed stated that HYV aman was more profitable than LT aman
- costs of production of HYV aman are higher than LT aman
- HYV aman seedlings are scarce every year
- sharecropping systems in which the owner provides no inputs and receives 50% of output are a disincentive
- farmers receive little advice or encouragement to grow HYV aman from the extension service
- lack of cash (or credit) to purchase inputs is a disincentive
- damage by tidal bores, insect and pests are more serious (and expensive) for HYV aman.

Whether or not these reasons are convincing it is clear that it is unrealistic to expect farmers to plant HYV aman to the extent which the model (or MPO) would expect. Thus in formulating "future with" cropping patterns only modest increases in HYV aman have been incorporated. In estimating cropping intensities for LT aman, the 1 in 2 year model predictions have been used as the basis for deciding areas likely to be grown in the "future with" project situation. The basis of these selected intensities is shown in Table E.4.6 and these are discussed below.

TABLE E.4.3  
Comparison of Model Areas(1:5 wet year), Survey Areas, DAE and BBS Areas

| AREAS       | Gross       | Net   | HYV without project |         | HYV with project |         | LT    |         | Actual                                    |         | Total    |
|-------------|-------------|-------|---------------------|---------|------------------|---------|-------|---------|---|---------|----------|
|             |             |       | Aman                | LT Aman | Aman             | LT Aman | Aman  | LT Aman | HYV Aman                                  | LT Aman |          |
| Zone A      | Probability |       | (1:5)               | (1:5)   | (1:5)            | (1:5)   | (1:5) | (1:5)   |   |         |          |
|             | A1          | 10035 | 0.92                | 0.95    | 7461             | 7618    | 7383  | 7618    |   |         |          |
|             | A2          | 8456  | 0.78                | 0.91    | 6023             | 6420    | 6023  | 6420    |   |         |          |
|             | A3          | 10841 | 1                   | 1       | 8484             | 8484    | 8484  | 8484    |   |         |          |
|             | Total       | 29332 |                     |         | 21968            | 22522   | 21890 | 22522   | 0.185                                     | 0.72    | 20776    |
| Zone B      | B1          | 8296  | 0.01                | 0.03    | 148              | 2611    | 2118  | 2611    | Ratio, Model:Survey                       |         | 0.95     |
|             | B2          | 11851 | 0.21                | 0.34    | 2393             | 6123    | 5349  | 6123    | Error, difference:NCA                     |         | 0.05     |
|             | B3          | 3555  | 0.01                | 0.02    | 42               | 127     | 42    | 127     | BBS area                                  |         |          |
|             | B4          | 7703  | 0                   | 0       | 0                | 2562    | 1281  | 2562    | DAE area                                  |         |          |
|             | B5          | 4148  | 0.19                | 0.34    | 838              | 2389    | 2389  | 2389    | MPO HYV Aman                              |         | 20085    |
| Zone C      | Total       | 35553 |                     |         | 3421             | 13862   | 11180 | 13862   | 0.03                                      | 0.386   | 8784     |
|             | C1          | 3921  | 0.46                | 0.62    | 1640             | 2487    | 2222  | 2487    | Ratio, Model:Survey                       |         | 2.57     |
|             | C2          | 1134  | 0.07                | 0.21    | 238              | 930     | 646   | 930     | Error, difference:NCA                     |         | -0.25    |
|             | C3          | 3361  | 0.02                | 0.1     | 227              | 453     | 363   | 453     | BBS area                                  |         |          |
|             | C4          | 6442  | 0.11                | 0.13    | 565              | 1000    | 782   | 1000    | DAE area                                  |         |          |
| Zone D      | C5          | 4761  | 0.06                | 0.09    | 289              | 482     | 353   | 482     | MPO HYV Aman                              |         | 8511     |
|             | C6          | 5882  | 0.68                | 0.83    | 3293             | 3849    | 3770  | 3849    | MPO LT Aman                               |         |          |
|             | C7          | 3361  | 0.15                | 0.33    | 748              | 2245    | 2222  | 2245    |   |         |          |
|             | C8          | 3361  | 0.02                | 0.05    | 113              | 2109    | 1746  | 2109    |   |         |          |
|             | Total       | 32769 |                     |         | 7114             | 13553   | 12104 | 13553   | 0.029                                     | 0.416   | 9838     |
| Zone E      | D1          | 7486  | 0.01                | 0.03    | 138              | 783     | 461   | 783     | Ratio, Model:Survey                       |         | 1.38     |
|             | D2          | 7015  | 0.06                | 0.08    | 339              | 1016    | 508   | 1016    | Error, difference:NCA                     |         | -0.12    |
|             | D3          | 6224  | 0.03                | 0.09    | 337              | 1684    | 936   | 1684    | BBS area                                  |         |          |
|             | D4          | 7010  | 0                   | 0.01    | 51               | 102     | 102   | 102     | DAE area                                  |         |          |
|             | D5          | 3618  | 0                   | 0.01    | 22               | 45      | 0     | 45      | MPO HYV Aman                              |         |          |
| Zone F      | D6          | 13215 | 0                   | 0.01    | 89               | 179     | 89    | 179     | MPO LT Aman                               |         | 12047    |
|             | D7          | 9143  | 0                   | 0.01    | 69               | 137     | 69    | 137     |   |         |          |
|             | D8          | 9448  | 0                   | 0       | 0                | 0       | 0     | 0       |   |         |          |
|             | Total       | 63160 |                     |         | 1045             | 3946    | 2164  | 3946    | 0.016                                     | 0.027   | 1829     |
| Grand Total |             |       |                     |         |                  |         |       |         | Ratio, Model:Survey                       |         | 1.75     |
|             |             |       |                     |         |                  |         |       |         | Error, difference:NCA                     |         | -0.02    |
|             |             |       |                     |         |                  |         |       |         | BBS area                                  |         |          |
|             |             |       |                     |         |                  |         |       |         | DAE area                                  |         |          |
|             |             |       |                     |         |                  |         |       |         | MPO HYV Aman                              |         |          |
| Grand Total |             |       |                     |         |                  |         |       |         | MPO LT Aman                               |         | 8548     |
|             |             |       |                     |         |                  |         |       |         | Ratio Present T. Aman to Model Prediction |         | 41226.18 |
|             |             |       |                     |         |                  |         |       |         | Error, difference:NCA                     |         | 1.23     |
|             |             |       |                     |         |                  |         |       |         | BBS area                                  |         | -0.07    |
|             |             |       |                     |         |                  |         |       |         | DAE area                                  |         |          |
| Grand Total |             |       |                     |         |                  |         |       |         | MPO area                                  |         | 24701.81 |
|             |             |       |                     |         |                  |         |       |         | HYV Aman                                  |         | 24489.60 |
|             |             |       |                     |         |                  |         |       |         | LT Aman                                   |         | 49191.41 |
|             |             |       |                     |         |                  |         |       |         | Total MPO                                 |         |          |
|             |             |       |                     |         |                  |         |       |         |   |         |          |



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TABLE E.4.5

Summary of Model Predictions, Survey Results, and MPO Predictions

|                    | Zone A |       | Zone B |      | Zone C |       | Zone D |      | Total |       |
|--------------------|--------|-------|--------|------|--------|-------|--------|------|-------|-------|
| Probability        | 1:5    | 1:2   | 1:5    | 1:2  | 1:5    | 1:2   | 1:5    | 1:2  | 1:5   | 1:2   |
| Model Predictions  |        |       |        |      |        |       |        |      |       |       |
| HYV Aman           | 20872  |       | 2016   |      | 5096   |       | 412    |      | 28396 |       |
| LT Aman            | 21968  | 22522 | 3421   | 6648 | 7114   | 10938 | 1045   | 3705 | 33548 | 43813 |
| Total              | 21968  | 22522 | 3421   | 6648 | 7114   | 10938 | 1045   | 3705 | 33548 | 43813 |
| Survey Predictions |        |       |        |      |        |       |        |      |       |       |
| HYV Aman           | 4247   |       | 633    |      | 641    |       | 681    |      | 6202  |       |
| LT Aman            | 16529  |       | 8150   |      | 9197   |       | 1149   |      | 35025 |       |
| Total              | 20776  |       | 8783   |      | 9838   |       | 1830   |      | 41227 |       |
| MPO Predictions    |        |       |        |      |        |       |        |      |       |       |
| HYV Aman           | 13987  |       | 3297   |      | 5738   |       | 1680   |      | 24702 |       |
| LT Aman            | 6099   |       | 5214   |      | 6308   |       | 6860   |      | 24481 |       |
| Total              | 20086  |       | 8511   |      | 12046  |       | 8540   |      | 49183 |       |

Note: MPO predictions are based on flood phase by the model.

A comparison between MPO and model flood phases is presented below:

|       | F0  | F1  | F2  | F3+ |
|-------|-----|-----|-----|-----|
| Model | 24% | 20% | 54% | 2%  |
| MPO   | 7%  | 38% | 50% | 5%  |

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**TABLE E.4.6**

**Areas of LT and HYV Aman**

|                          |               |    |    |      | Percentage of NCA |      |
|--------------------------|---------------|----|----|------|-------------------|------|
|                          |               | FO | F1 | F2 + | LT Aman           | HYV  |
| Aman                     |               |    |    |      |                   |      |
| Zone A                   | Present + FWO | 91 | 9  | 0    | 71.9              | 18.6 |
|                          | Future with   | 95 | 5  | 0    | 73.0              | 19.0 |
| Theoretical Maximum area |               |    |    |      | 99.0              | 95.0 |
| Zone B                   | Present + FWO | 4  | 33 | 63   | 39.0              | 3.0  |
|                          | Future with   | 42 | 50 | 8    | 58.0              | 17.0 |
| Theoretical Maximum      |               |    |    |      | 81.7              | 53.0 |
| Zone C                   | Present + FWO | 17 | 39 | 44   | 41.6              | 3.0  |
|                          | Future        | 47 | 32 | 21   | 50.0              | 17.0 |
| Theoretical Maximum      |               |    |    |      | 73.1              | 53.0 |
| Zone D                   | Present + FWO | 1  | 9  | 90   | 2.7               | 1.6  |
|                          | Future with   | 2  | 28 | 70   | 7.0               | 5.0  |
| Theoretical Maximum      |               |    |    |      | 25.0              | 5.0  |

**Notes:**

**Zone A**

Both HYV and LT aman are increased marginally in the "future with", in the same proportions as HYV and LT aman are grown at present. The present situation, where 90% of the possible T Aman area is actually cultivated is taken as a maximum for the other Zones in the "future with".

**Zone B**

A substantial change in flooding regimes is expected. HYV aman currently occupies 31% of the area predicted by the model and is expected to account for the same proportion in the future. LT aman which currently exceeds "safely grown" areas predicted by the model is expected to be grown over an area of 90% of model predictions in the "future with", after having deducted the area planted to HYV aman.



### **Zone C**

HYV aman currently occupies 13% of the area predicted by the model. In future it is expected to cover the same proportion of the area as in Zone B, as the area currently grown is very similar to zone B. LT aman currently exceeds model predictions and is expected to be cultivated over 90% of model predictions in the "future with" after having deducted the area planted to HYV aman.

### **Zone D**

At present HYV aman is planted over an area greater than the model allows. Thus in the future 100% of HYV aman predicted area is included (which is only 5% of NCA). LT aman areas currently occupy an area rather smaller than the model predicts and consequently the same proportion is applied in the "future with" cropping patterns.

### **Crop Yields**

Results of the survey for Noakhali are given in Table E.4.7 DAE and BBS figures are averages for the thanas in both project areas over the period 1989-90 to 1991-92. Rice yields are in tonnes of paddy per hectare. In general the farmer survey yields are higher than both DAE and BBS yields although DAE yield estimates are generally higher than BBS's. The higher yield rates used in the crop budgets reflect the farmer survey as these yields are to some extent confirmed by the survey done by FAP 12 in the Meghna Dhonaghoda Irrigation Project and by the Deep Tubewell Monitoring Project which covers part of the northern area and which gave a yield of 5.5 tonnes per hectare for boro.

### **Future Yields**

Previous appraisals of FCDI projects have commonly assumed that substantial input supply and agricultural extension programmes would accompany projects, and that farmers would use recommended doses of inputs and achieve yields appropriate to these levels of inputs. In reality, while FCDI projects and irrigation have generally been found to lead to changes in cropping patterns (due to altered flood phasing), it is not immediately apparent that they have resulted in an increase in input applications or yields received for a given crop type grown under the same land and water conditions as before.

TABLE E.4.7

Crop Yields Used in Economic Models

|                 | Noakhali |          |          | Used in |
|-----------------|----------|----------|----------|---------|
|                 | Farmer   |          |          | Budgets |
|                 | Survey   | DAE      | BBS      |         |
| B Aus, local    | 1.69     | 1.34     | 1.57     | 1.60    |
| B Aus, HYV      | 2.6      | 2.78     |          | 2.40    |
| T Aus, local    | 2.25     |          | 2.98     | 2.40    |
| T Aus, HYV irri |          |          |          | 3.25    |
| T Aus, HYV n-ir | 2.88     |          | 2.30     | 2.85    |
| Mixed aus/aman  | 2.29     |          |          | 2.30    |
| B Aman local dw | 1.56     | 1.63     | 1.71     | 1.60    |
| T Aman local dw | 2.19     |          |          | 2.00    |
| T Aman, local   | 2.14     | 2.20     | 2.0      | 2.10    |
| T Aman HYV irr  |          |          |          | 3.75    |
| T Aman HYV n-ir | 2.90     | 3.74     | 2.63     | 3.55    |
| Boro, local     | 1.41     | 2.39     | 2.13     | 2.80    |
| Boro, HYV irrig | 5.08     | 4.46     | 4.17     | 5.00    |
| Wheat irrig.    | 1.38     | -        | -        | 2.25    |
| Wheat unirrig.  | 1.29     | -        | -        | 1.80    |
| Potato irrig.   | 24.25    | 12.24(1) | 10.28(1) | 15.00   |
| Potato unirrig. | 11.96    | 5.51(1)  | 7.65(1)  | 10.00   |
| Jute            | 1.69     | 1.53     | 1.72     | 1.90    |
| Pulses: keshari | 0.57     | 0.63     | 0.70     | 0.70    |
| mung            | 0.62     |          | 0.60     | 0.60    |
| masur           | 0.59     |          | 0.73     | 0.50    |
| mash            | 0.61     |          |          | 0.70    |
| Mustard         | 0.84     |          | 0.69     | 0.75    |
| Spices (chilli) | 2.62     |          | 2.76     | 4.00    |
| Veg. (brinjal)  | 10.59    |          | 7.19     | 8.00    |

Note (1) BBS and DAE potato yields are for HYV and local and not by irrigation status.

LD

In one of the most detailed recent evaluations of a major FCDI project (Thompson 1989), no differences were found in yields for winter crops (mainly boro) and aus between Chandpur Irrigation Project (CIP) and adjacent 'control' areas outside the project boundaries. In summarising the yield impacts of FCDI the following extract from Thompson is particularly relevant:

"Flood protection appears to be successful in maintaining yields closer to 'normal' in unusual flood years, compared with unprotected areas, but otherwise CIP has not provided an additional benefit over the switch in cropping pattern. That is, yields in a normal year are not higher compared to outside when the same type of paddy is considered. In general this probably reflects levels of input use... fertiliser use for a given crop type is not higher inside CIP compared to outside areas. Thus CIP does not appear to have provided more effective extension services relative to non-project areas, nor has any supposed increase in wealth due to more productive agriculture been reinvested as working capital in an attempt to further increase yields."

This finding is supported by detailed analysis of farmer survey results which did not identify any improvement in yield or associated change in input use for the same crop grown on higher, and therefore less flood-prone, land. Although evaluations of completed projects by FAP 12 has in some cases identified yield improvements inside FCD project areas (see Table E.4.8), it concluded that:

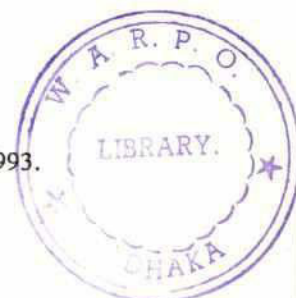
"in most projects the major impact on weighted mean paddy yields is from farmers switching to more productive types of paddy when hydrological conditions change sufficiently to permit this".

For the purposes of the economic analysis, it has been assumed that for a given crop a single yield value (and level of inputs) is applicable in both the without and with project conditions. The yield figures used have been assumed to allow for normal levels of crop damage due to flooding. Differences in yields between the with and without project cases have been assumed only in cases where flood protection would cause a reduction in the average annual level of crop damage and which are accounted for separately.

Similarly no difference is assumed between present and future yields (with and without the project). There is no evidence that there is an upward long term trend in the yields of individual crops. Analysis of BBS statistics by IFDC<sup>1</sup> indicate that although hyv boro yields rose by 0.3% per year from 1973 to 1979, they then declined by 0.4% per year up to 1989, despite increased use of fertiliser. This is attributed to an increasing proportion of the expanding area being grown under less suitable conditions. Boro yields are best on heavy soils and these areas were the first to be cultivated with the crop. As boro expands it has in turn pushed wheat, pulses and oilseeds on to more marginal land so their yields have also suffered. Analysis of data on hyv aman paddy IFDC<sup>2</sup> shows an annual yield decline from 1972 to 1988 of 0.5%. Analysis of yields reported by BBS for the region shows a pattern of increasing yields for major crops over the last six years (see Agriculture Annex). Thus the combination of the periods reported above (1973-79, 1979-89, 1972-88 and 1987-92) suggest short term fluctuations producing a static situation in the long term. Static and declining yields are also attributed to increasing cropping intensity, reduced flooding (which may add organic matter to the soil, reduced production of pulses and use of animal manure) both of which improve soil structure and fertility.

<sup>1</sup> Farm level Fertiliser Use Survey, 1990/1 Rabi/Boro Season, I Jahan, K Sanyal, IFDC, 1993.

<sup>2</sup> Farm Level Fertiliser Use Survey, 1989 Aman Season, Sidhu and Ahan, IFDC 1991





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**TABLE E.4.8**

**Comparison of Yield Data From different Sources**

| Tonns per hectare<br>(rice as paddy) | Farmer<br>survey | FAP 12 (MDIP) |         | BBS avg.<br>1989-91 | Used<br>in crop<br>budgets |
|--------------------------------------|------------------|---------------|---------|---------------------|----------------------------|
|                                      |                  | project       | outside |                     |                            |
| B Aus, local                         | 1.69             | 2.08          | 2.04    | 1.57                | 1.6                        |
| B Aus, HYB                           | 2.6              | 3.59          |         | -                   | 2.4                        |
| T Aus, local                         | 2.25             | 2.99          |         | 2.98                | 2.4                        |
| T Aus, HYV                           | 2.88             | 4.22          |         | 2.30                | 2.85                       |
| Mixed aus/aman                       | 2.29             | 1.71          | 1.14    | -                   | 2.30                       |
| B Aman local d.w.                    | 1.56             | 1.87          | 2.04    | 1.71                | 1.6                        |
| T Aman, local d.w.                   | 2.14             |               |         | -                   | 2.10                       |
| TAman, local                         | 2.14             | 3.31          | 1.29    | 2.00                | 2.10                       |
| TAman, HYV                           | 2.90             | 4.66          | 2.8     | 2.63                | 3.55                       |
| Boro, local                          | 1.42             | 3.15          |         | 2.13                | 2.80                       |
| Boro, HYV                            | 5.08             | 5.04          | 4.47    | 4.17                | 5.0                        |
| Wheat irrigated                      | 1.38             | 1.92          | 1.98    | -                   | 2.25                       |
| Wheat unirrigated                    | 1.29             | 1.96          | 1.98    | 1.27                | 1.80                       |
| Potato irrigated                     | 24.25            | 9.52          | 17.38   | 10.28               | 15.00                      |
| Potato unirrigated                   | 11.96            | 9.52          | 17.38   | 7.65                | 11.00                      |
| Jute                                 | 1.94             | 1.26          | 1.02    | 1.72                | 1.90                       |
| Pulses: keshari                      | 0.57             |               | 0.9     | 0.61                | 0.70                       |
| mung                                 | 0.62             |               | 0.9     | 1.31                | 0.60                       |
| musur                                | 0.59             |               | 0.9     | 0.97                | 0.50                       |
| mash                                 | 0.61             |               | 0.9     | -                   | 0.70                       |
| Mustard                              | 0.84             | 0.74          | 0.49    | 0.69                | 0.75                       |
| Spicdes (chilli)                     | 1.60             | 1.21          | 0.58    | 1.86                | 4.00                       |
| Veg. (brinjal)                       | 8.01             |               |         | 7.17                | 8.00                       |

#### **E.4.3.2 Cropping Patterns**

Cropping patterns for each of the Zones, prepared on the bases discussed above are presented in Tables E.4.9, E.4.10, E.4.11 and E.4.12.

##### **a) Future Without Project Development**

"Future without" project development is assumed to be the same as the present. Little or no further groundwater development is anticipated and no improvement in flooding regimes is possible without major interventions.

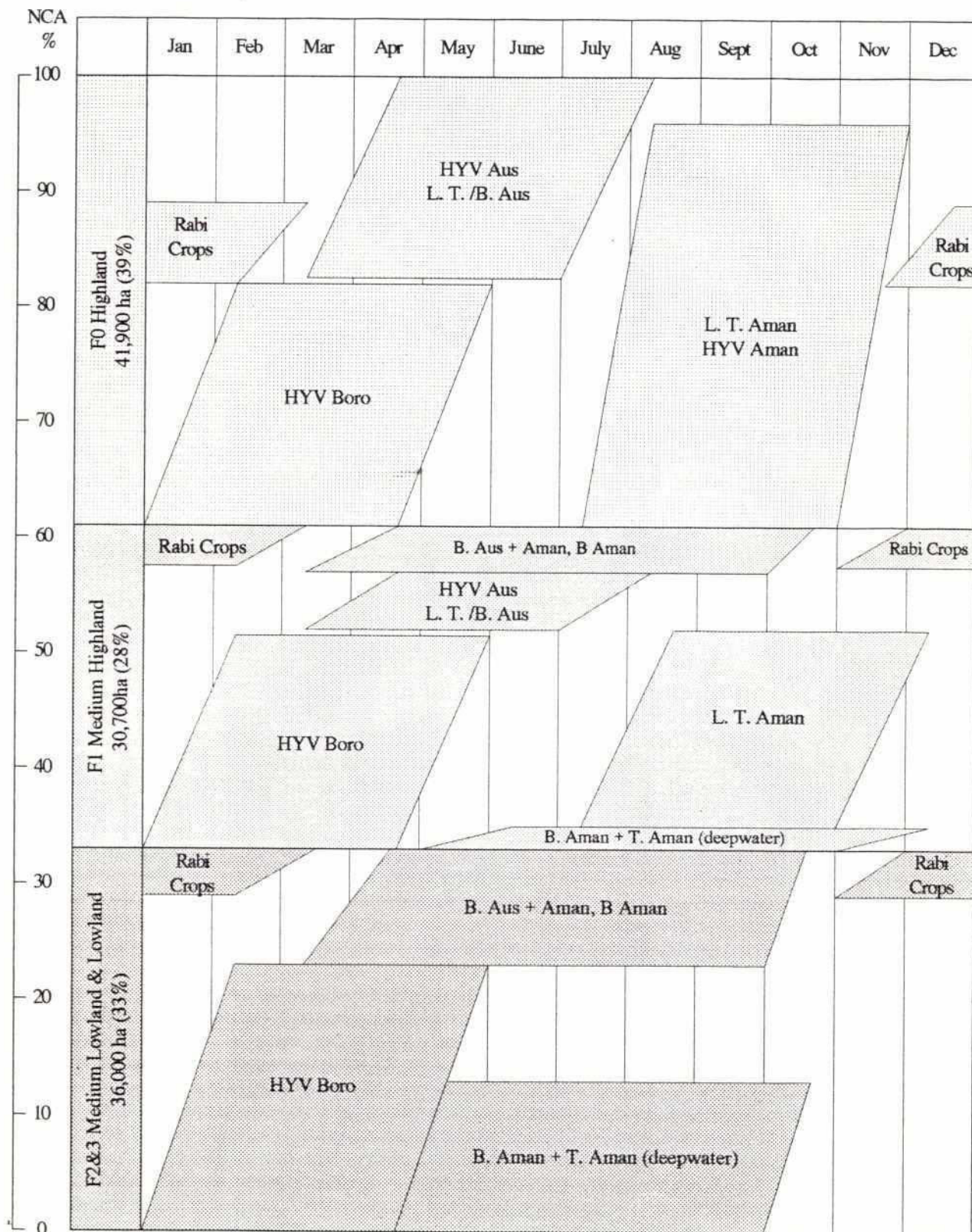
##### **b) Future With Project Development**

"Future with" project development is based on

- (1) Increases in the availability of water for an expansion of irrigation, and increased cultivation of boro
- (2) Improved flooding regimes which will enable improved flooding regimes which will enable larger areas of T. aman to be grown

The schematic cropping pattern for the whole project area is shown in Figure E.4.2.

**Figure E.4.2**  
**Schematic Cropping Pattern under Future With Project Condition**  
**[FW] in the Noakhali North Project Area**





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TABLE E.4.9

Zone A: Summary of Cropping Pattern Changes

|                   | Year 1 | Future<br>w/out(1) | Future<br>w/out(2) | Future<br>with(1) | Future<br>with(2) |
|-------------------|--------|--------------------|--------------------|-------------------|-------------------|
| B Aus, local      | 26.2%  | 26.2%              | 26.2%              | 19.9%             | 19.9%             |
| B Aus, HYV        | 15.8%  | 15.8%              | 15.8%              | 15.8%             | 15.8%             |
| T Aus, local      | 1.3%   | 1.3%               | 1.3%               | 1.3%              | 1.3%              |
| T Aus, HYV irri   | 0.0%   | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| T Aus, HYV n-ir   | 3.0%   | 3.0%               | 3.0%               | 3.0%              | 3.0%              |
| Mixed aus/aman    | 0.7%   | 0.7%               | 0.7%               | 0.0%              | 0.0%              |
| B Aman local dw   | 2.8%   | 2.8%               | 2.8%               | 0.0%              | 0.0%              |
| T Aman local dw   | 0.0%   | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| T Aman, local     | 71.9%  | 71.9%              | 71.9%              | 73.0%             | 73.0%             |
| T Aman HYV irri   | 0.0%   | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| T Aman HYV n-ir   | 18.6%  | 18.6%              | 18.6%              | 19.0%             | 19.0%             |
| Boro, local       | 0.0%   | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Boro, HYV irrig   | 17.1%  | 17.1%              | 17.1%              | 59.0%             | 59.0%             |
| Boro HYV p-irrig. | 0.0%   | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Wheat irrig.      | 0.1%   | 0.1%               | 0.1%               | 0.1%              | 0.1%              |
| Wheat unirrig.    | 0.4%   | 0.4%               | 0.4%               | 0.4%              | 0.4%              |
| Potato irrig.     | 0.2%   | 0.2%               | 0.2%               | 0.2%              | 0.2%              |
| Potato unirrig.   | 0.6%   | 0.6%               | 0.6%               | 0.6%              | 0.6%              |
| Jute              | 0.2%   | 0.2%               | 0.2%               | 0.0%              | 0.0%              |
| Pulses: ave.      | 10.9%  | 10.9%              | 10.9%              | 8.9%              | 8.9%              |
| Mustard           | 5.6%   | 5.6%               | 5.6%               | 3.4%              | 3.4%              |
| Spices (chilli)   | 7.7%   | 7.7%               | 7.7%               | 7.7%              | 7.7%              |
| Veg. (brinjal)    | 1.1%   | 1.1%               | 1.1%               | 1.1%              | 1.1%              |
| total             | 184.2% | 184.2%             | 184.2%             | 213.4%            | 213.4%            |

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TABLE E.4.10

Zone B: Summary of Cropping Pattern Changes

|                   | (% of NCA) |                    |                    |                   |                   |
|-------------------|------------|--------------------|--------------------|-------------------|-------------------|
|                   | Year 1     | Future<br>w/out(1) | Future<br>w/out(2) | Future<br>with(1) | Future<br>with(2) |
| B Aus, local      | 5.1%       | 5.1%               | 5.1%               | 5.1%              | 5.1%              |
| B Aus, HYV        | 0.5%       | 0.5%               | 0.5%               | 0.5%              | 0.5%              |
| T Aus, local      | 12.0%      | 12.0%              | 12.0%              | 10.0%             | 10.0%             |
| T Aus, HYV irri   | 0.7%       | 0.7%               | 0.7%               | 0.9%              | 0.9%              |
| T Aus, HYV n-ir   | 11.9%      | 11.9%              | 11.9%              | 11.7%             | 11.7%             |
| Mixed aus/aman    | 16.1%      | 16.1%              | 16.1%              | 8.4%              | 8.4%              |
| B Aman local dw   | 6.3%       | 6.3%               | 6.3%               | 6.0%              | 6.0%              |
| T Aman local dw   | 0.3%       | 0.3%               | 0.3%               | 0.3%              | 0.3%              |
| T Aman, local     | 38.7%      | 38.7%              | 38.7%              | 58.0%             | 58.0%             |
| T Aman HYV irri   | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| T Aman HYV n-ir   | 3.0%       | 3.0%               | 3.0%               | 17.0%             | 17.0%             |
| Boro, local       | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Boro, HYV irrig   | 51.0%      | 51.0%              | 51.0%              | 63.0%             | 63.0%             |
| Boro HYV p-irrig. | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Wheat irrig.      | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Wheat unirrig.    | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Potato irrig.     | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Potato unirrig.   | 0.2%       | 0.2%               | 0.2%               | 0.2%              | 0.2%              |
| Jute              | 0.2%       | 0.2%               | 0.2%               | 0.0%              | 0.0%              |
| Pulses: ave.      | 8.0%       | 8.0%               | 8.0%               | 8.0%              | 8.0%              |
| Mustard           | 0.1%       | 0.1%               | 0.1%               | 0.1%              | 0.1%              |
| Spices (chilli)   | 2.2%       | 2.2%               | 2.2%               | 2.2%              | 2.2%              |
| Veg. (brinjal)    | 0.6%       | 0.6%               | 0.6%               | 0.6%              | 0.6%              |
| total             | 156.9%     | 156.9%             | 156.9%             | 192.0%            | 192.0%            |

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TABLE E.4.11

Zone C: Summary of Cropping Pattern Changes

|                 | (% of NCA) |                    |                    |                   |                   |
|-----------------|------------|--------------------|--------------------|-------------------|-------------------|
|                 | Year 1     | Future<br>w/out(1) | Future<br>w/out(2) | Future<br>with(1) | Future<br>with(2) |
| B Aus, local    | 14.5%      | 14.5%              | 14.5%              | 6.8%              | 6.8%              |
| B Aus, HYV      | 4.7%       | 4.7%               | 4.7%               | 4.7%              | 4.7%              |
| T Aus, local    | 4.3%       | 4.3%               | 4.3%               | 4.3%              | 4.3%              |
| T Aus, HYV irri | 0.6%       | 0.6%               | 0.6%               | 0.6%              | 0.6%              |
| T Aus, HYV n-ir | 11.5%      | 11.5%              | 11.5%              | 11.5%             | 11.5%             |
| Mixed aus/aman  | 6.8%       | 6.8%               | 6.8%               | 5.0%              | 5.0%              |
| B Aman local dw | 17.4%      | 17.4%              | 17.4%              | 5.1%              | 5.1%              |
| T Aman local dw | 4.3%       | 4.3%               | 4.3%               | 2.1%              | 2.1%              |
| T Aman, local   | 41.6%      | 41.6%              | 41.6%              | 50.0%             | 50.0%             |
| T Aman HYV irri | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| T Aman HYV n-ir | 2.9%       | 2.9%               | 2.9%               | 17.0%             | 17.0%             |
| Boro, local     | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Boro, HYV irrig | 48.0%      | 48.0%              | 48.0%              | 67.0%             | 67.0%             |
| Boro HYV p-irr. | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Wheat irrig.    | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Wheat unirrig.  | 0.2%       | 0.2%               | 0.2%               | 0.2%              | 0.2%              |
| Potato irrig.   | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Potato unirrig. | 0.2%       | 0.2%               | 0.2%               | 0.2%              | 0.2%              |
| Jute            | 0.7%       | 0.7%               | 0.7%               | 0.0%              | 0.0%              |
| Pulses; ave.    | 5.8%       | 5.8%               | 5.8%               | 5.8%              | 5.8%              |
| Mustard         | 4.6%       | 4.6%               | 4.6%               | 4.6%              | 4.6%              |
| Spices (chilli) | 3.1%       | 3.1%               | 3.1%               | 3.1%              | 3.1%              |
| Veg. (brinjal)  | 1.4%       | 1.4%               | 1.4%               | 1.4%              | 1.4%              |
| total           | 172.6%     | 172.6%             | 172.6%             | 189.4%            | 189.4%            |



TABLE E.4.12

Zone D: Summary of Cropping Pattern Changes

|                   | (% of NCA) |                    |                    |                   |                   |
|-------------------|------------|--------------------|--------------------|-------------------|-------------------|
|                   | Year 1     | Future<br>w/out(1) | Future<br>w/out(2) | Future<br>with(1) | Future<br>with(2) |
| B Aus, local      | 3.5%       | 3.5%               | 3.5%               | 3.5%              | 3.5%              |
| B Aus, HYV        | 0.5%       | 0.5%               | 0.5%               | 0.5%              | 0.5%              |
| T Aus, local      | 0.3%       | 0.3%               | 0.3%               | 0.3%              | 0.3%              |
| T Aus, HYV irri   | 0.0%       | 0.0%               | 0.0%               | 0.3%              | 0.3%              |
| T Aus, HYV n-ir   | 7.9%       | 7.9%               | 7.9%               | 7.6%              | 7.6%              |
| Mixed aus/aman    | 7.5%       | 7.5%               | 7.5%               | 7.5%              | 7.5%              |
| B Aman local dw   | 53.7%      | 53.7%              | 53.7%              | 44.4%             | 44.4%             |
| T Aman local dw   | 9.0%       | 9.0%               | 9.0%               | 9.0%              | 9.0%              |
| T Aman, local     | 2.7%       | 2.7%               | 2.7%               | 7.0%              | 7.0%              |
| T Aman HYV irri   | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| T Aman HYV n-ir   | 1.6%       | 1.6%               | 1.6%               | 5.0%              | 5.0%              |
| Boro, local       | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Boro, HYV irrig   | 58.1%      | 58.1%              | 58.1%              | 63.1%             | 63.1%             |
| Boro HYV p-irrig. | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Wheat irrig.      | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Wheat unirrig.    | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Potato irrig.     | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Potato unirrig.   | 0.1%       | 0.1%               | 0.1%               | 0.1%              | 0.1%              |
| Jute              | 1.3%       | 1.3%               | 1.3%               | 0.0%              | 0.0%              |
| Pulses: ave.      | 9.9%       | 9.9%               | 9.9%               | 9.9%              | 9.9%              |
| Mustard           | 0.0%       | 0.0%               | 0.0%               | 0.0%              | 0.0%              |
| Spices (chilli)   | 1.4%       | 1.4%               | 1.4%               | 1.4%              | 1.4%              |
| Veg. (brinjal)    | 0.3%       | 0.3%               | 0.3%               | 0.3%              | 0.3%              |
| total             | 157.9%     | 157.9%             | 157.9%             | 160.0%            | 160.0%            |

## E.4.4 Future Development Proposal

### E.4.4.1 Future Crop production

Future agricultural production is estimated on the basis of the future proposed cropping patterns and unit yields. Although the total production will not increase under future without-project [FWO] condition, per capita production of cereal grains will significantly reduce below 135kg per capita in 2023. Production of cereal grains under future with-project [FW] condition will increase about 20% and those will maintain the local population by supplying 166 kg per capita in 2023, as summarized in Table E.4.13 and Table E.4.14.

TABLE E.4.13

#### Per Capita Production of Cereal Grains in the Noakhali North Project Area

| Crop                               | Zone A  |            | Zone B  |            | Zone C  |            | Zone D  |            | Whole Area |            |
|------------------------------------|---------|------------|---------|------------|---------|------------|---------|------------|------------|------------|
|                                    | Total   | per capita | Total   | per capita | Total   | per capita | Total   | per capita | Total      | per capita |
|                                    | (ton)   | (kg)       | (ton)   | (kg)       | (ton)   | (kg)       | (ton)   | (kg)       | (ton)      | (kg)       |
| <u>Present Condition [PI]</u>      |         |            |         |            |         |            |         |            |            |            |
| Rice                               | 91,900  | 320.7      | 100,700 | 151.2      | 104,400 | 203.2      | 193,600 | 229.0      | 490,600    | 212.2      |
| Wheat                              | 200     | 0.7        | -       | -          | 100     | 0.2        | -       | -          | 300        | 0.1        |
| Total of Grains                    | 92,100  | 321.4      | 100,700 | 151.2      | 104,500 | 203.3      | 193,600 | 229.0      | 490,900    | 212.3      |
| <hr/>                              |         |            |         |            |         |            |         |            |            |            |
| Population *( '000)                | 286.6   |            | 666.1   |            | 513.9   |            | 845.5   |            | 2,312.1    |            |
| <hr/>                              |         |            |         |            |         |            |         |            |            |            |
| <u>Future without Project [WO]</u> |         |            |         |            |         |            |         |            |            |            |
| Rice                               | 91,900  | 204.5      | 100,700 | 96.4       | 104,400 | 129.6      | 193,600 | 146.1      | 490,600    | 135.3      |
| Wheat (rainfed)                    | 200     | 0.4        | -       | -          | 100     | 0.1        | -       | -          | 300        | 0.1        |
| Total of Grains                    | 92,100  | 205.0      | 100,700 | 96.4       | 104,500 | 129.7      | 193,600 | 146.1      | 490,900    | 135.4      |
| <hr/>                              |         |            |         |            |         |            |         |            |            |            |
| Population **('000)                | 449.3   |            | 1,044.3 |            | 805.7   |            | 1,325.4 |            | 3,624.7    |            |
| <hr/>                              |         |            |         |            |         |            |         |            |            |            |
| <u>Future with Project [FW]</u>    |         |            |         |            |         |            |         |            |            |            |
| Rice                               | 137,100 | 305.1      | 126,700 | 121.3      | 131,200 | 162.8      | 206,900 | 156.1      | 601,900    | 166.1      |
| Wheat (rainfed)                    | 200     | 0.4        | -       | -          | 100     | 0.1        | -       | -          | 300        | 0.1        |
| Total of Grains                    | 137,300 | 305.6      | 126,700 | 121.3      | 131,300 | 163.0      | 206,900 | 156.1      | 602,200    | 166.1      |
| <hr/>                              |         |            |         |            |         |            |         |            |            |            |
| Population **('000)                | 449.3   |            | 1,044.3 |            | 805.7   |            | 1,325.4 |            | 3,624.7    |            |

Remarks: \*:population in 1993, \*\*:population in 2023, as projected in Annex G Socio-Economy

TABLE E.4.14

**Per Capita Production under Present and Future Condition  
in the Noakhali North Project Area**

| Crop                               | Zone A         |                       | Zone B         |                       | Zone C         |                       | Zone D         |                       | Whole Area     |                       |
|------------------------------------|----------------|-----------------------|----------------|-----------------------|----------------|-----------------------|----------------|-----------------------|----------------|-----------------------|
|                                    | Total<br>(ton) | per<br>capita<br>(kg) | Total<br>(ton) | per<br>capita<br>(kg) | Total<br>(ton) | per<br>capita<br>(kg) | Total<br>(ton) | per<br>capita<br>(kg) | Total<br>(ton) | per<br>capita<br>(kg) |
| <u>Present Condition [P]</u>       |                |                       |                |                       |                |                       |                |                       |                |                       |
| Rice                               | 91,900         | 320.7                 | 100,700        | 151.2                 | 104,400        | 203.2                 | 193,600        | 229.0                 | 490,600        | 212.2                 |
| Wheat                              | 200            | 0.7                   | -              | -                     | 100            | 0.2                   | -              | -                     | 300            | 0.1                   |
| Total                              | 92,100         | <u>321.4</u>          | 100,700        | <u>151.2</u>          | 104,500        | <u>203.3</u>          | 193,600        | <u>229.0</u>          | 490,900        | <u>212.3</u>          |
| Pulses                             | 1,700          | 5.9                   | 1,100          | 1.7                   | 800            | 1.6                   | 2,900          | 3.4                   | 6,500          | 2.8                   |
| Oilseeds                           | 1,000          | 3.5                   | 0              | 0.0                   | 800            | 1.6                   | -              | -                     | 1,800          | 0.8                   |
| Potato                             | 1,800          | 6.3                   | 400            | 0.6                   | 400            | 0.8                   | 400            | 0.5                   | 3,000          | 1.3                   |
| Winter Vegetables                  | 2,000          | 7.0                   | 1,000          | 1.5                   | 2,300          | 4.5                   | 1,000          | 1.2                   | 6,300          | 2.7                   |
| Spices                             | 7,100          | 24.8                  | 1,900          | 2.9                   | 2,700          | 5.3                   | 2,400          | 2.8                   | 14,100         | 6.1                   |
| Jute                               | 100            | 0.3                   | 100            | 0.2                   | 300            | 0.6                   | 1,000          | 1.2                   | 1,500          | 0.6                   |
| Summer Vegetable                   | -              | -                     | 200            | -                     | 200            | 0.4                   | -              | -                     | 400            | 0.2                   |
| Population* ('000)                 | 286.6          |                       | 666.1          |                       | 513.9          |                       | 845.5          |                       | 2,312.1        |                       |
| <u>Future without Project [WO]</u> |                |                       |                |                       |                |                       |                |                       |                |                       |
| Rice                               | 91,900         | 204.5                 | 100,700        | 96.4                  | 104,400        | 129.6                 | 193,600        | 146.1                 | 490,600        | 135.3                 |
| Wheat                              | 200            | 0.4                   | -              | -                     | 100            | 0.1                   | -              | -                     | 300            | 0.1                   |
| Total                              | 92,100         | <u>205.0</u>          | 100,700        | <u>96.4</u>           | 104,500        | <u>129.7</u>          | 193,600        | <u>146.1</u>          | 490,900        | <u>135.4</u>          |
| Pulses                             | 1,700          | 3.8                   | 1,100          | 1.1                   | 800            | 1.0                   | 2,900          | 2.2                   | 6,500          | 1.8                   |
| Oilseeds                           | 1,000          | 2.2                   | 0              | 0.0                   | 800            | 1.0                   | -              | -                     | 1,800          | 0.5                   |
| Potato                             | 1,800          | 4.0                   | 400            | 0.4                   | 400            | 0.5                   | 400            | 0.3                   | 3,000          | 0.8                   |
| Winter Vegetables                  | 2,000          | 4.5                   | 1,000          | 1.0                   | 2,300          | 2.9                   | 1,000          | 0.8                   | 6,300          | 1.7                   |
| Spices                             | 7,100          | 15.8                  | 1,900          | 1.8                   | 2,700          | 3.4                   | 2,400          | 1.8                   | 14,100         | 3.9                   |
| Jute                               | 100            | 0.2                   | 100            | 0.1                   | 300            | 0.4                   | 1,000          | 0.8                   | 1,500          | 0.4                   |
| Summer Vegetable                   | -              | -                     | 200            | 0.2                   | 200            | 0.2                   | -              | -                     | 400            | 0.1                   |
| Population** ('000)                | 449.3          |                       | 1,044.3        |                       | 805.7          |                       | 1,325.4        |                       | 3,624.7        |                       |
| <u>Future with Project [FW]</u>    |                |                       |                |                       |                |                       |                |                       |                |                       |
| Rice                               | 137,100        | 305.1                 | 126,700        | 121.3                 | 131,200        | 162.8                 | 206,900        | 156.1                 | 601,900        | 166.1                 |
| Wheat                              | 200            | 0.4                   | -              | -                     | 100            | 0.1                   | -              | -                     | 300            | 0.1                   |
| Total                              | 137,300        | <u>305.6</u>          | 126,700        | <u>121.3</u>          | 131,300        | <u>163.0</u>          | 206,900        | <u>156.1</u>          | 602,200        | <u>166.1</u>          |
| Pulses                             | 1,400          | 3.1                   | 1,100          | 1.1                   | 900            | 1.1                   | 2,900          | 2.2                   | 6,300          | 1.7                   |
| Oilseeds                           | 600            | 1.3                   | 0              | 0.0                   | 800            | 1.0                   | -              | -                     | 1,400          | 0.4                   |
| Potato                             | 1,800          | 4.0                   | 400            | 0.4                   | 400            | 0.5                   | 400            | 0.3                   | 3,000          | 0.8                   |
| Winter Vegetables                  | 2,000          | 4.5                   | 1,000          | 1.0                   | 2,300          | 2.9                   | 1,000          | 0.8                   | 6,300          | 1.7                   |
| Spices                             | 7,100          | 15.8                  | 1,900          | 1.8                   | 2,700          | 3.4                   | 2,400          | 1.8                   | 14,100         | 3.9                   |
| Jute                               | -              | -                     | -              | -                     | -              | -                     | -              | -                     | -              | -                     |
| Summer Vegetable                   | -              | -                     | 200            | 0.2                   | 200            | 0.2                   | -              | -                     | 400            | 0.1                   |
| Population** ('000)                | 449.3          |                       | 1,044.3        |                       | 805.7          |                       | 1,325.4        |                       | 3,624.7        |                       |

Remarks: \*:population in 1993, \*\*:population in 2023, as projected in Annex G Socio-Economy



## CHAPTER E.5

### POSSIBLE CONSTRAINTS TO FUTURE DEVELOPMENTS

#### E.5.1 Availability of Labour Force and Draft Animal

Current farming activities are mainly done by farm labours in the form of family members and draught animals as well as labour hired from other households. However, according to the farmers survey, the majority of farmers reported that delay of cropping can be caused by shortage of labour force and draught animals, particularly for land preparation. Consequently, crops might not be harvested at the due time and this results in lower yields than the normal. This shortage is also corroborated by the fact that power tillers are utilized for land preparation by about 33% of farmers in the project area. In the future, requirement of labour force and draught animals will further increase under both without-project and with-project conditions. Therefore, the proposed cropping patterns are examined in terms of requirement and availability of labour force and draught animals in the following sub-sections. Outline of the estimation of requirement and availability is presented in Tables E.5.1 to E.5.3 for both of labour force and draught animal.

##### E.5.1.1 Labour

Annual total requirement of labour force in the project area is calculated at 33.2 million man-days on the basis of the crop area of the proposed cropping pattern and unit labour requirement for each crop. Annual total labour force available for agriculture in the project area is estimated at 143.1 million man-days in 1993 and 224.3 million in 2023, assuming that (1) 33% of population is available for labour force in adult equivalent basis, (2) 75% of available labour force engage in agriculture, (4) annual working days are 250 days, (5) population in 1993 and 2023 projected as described in Annex G is applied. Farming practices of the proposed cropping pattern requires 23% of the annual labour force available for agriculture in 1993. This proportion of requirement to availability will be reduced to 15% in 2023 owing to population increase.

In addition to annual balance in the above, analysis at peak requirement period is examined for HYV boro crop, which will occupy the largest crop area in the proposed cropping pattern. Peak requirement reaches 176,200 man days in early January through calculating requirements of each practice on a 10-day basis. Daily total labour force available for agriculture is also estimated at 388,800 man days at present and 609,200 in 2023, applying the same assumption as in the above. At the peak requirement period in which the practices for nursery preparation, land preparation and transplanting are overlapped, cultivation of HYV boro on 68,400 ha requires 45% of the present available labour force in 1993. Even in the case of this peak requirement duplicating the practices of HYV boro crops with those of such crops as rabi crops and aus paddy, labour requirement will not exceed 72% of availability. This proportion will be reduced to around 30% in 2023.

These results indicate that the trends of population in the project area could sustain the future labour availability enough for the proposed cropping pattern, and no particular measures would be necessary to supplement labour force.

TABLE E.5.1

**Annual Requirement of Labour Force and Draught Animal  
under Future With Project Condition [FW] in the Noakhali North Project Area**

| Crops                                   | Total<br>Cropped | Labour<br>Requirement     |                                | Draught Animal<br>Requirement |                     |
|---|------------------|---------------------------|--------------------------------|-------------------------------|---------------------|
|   | Area<br>(ha)     | Unit Rate<br>(man-day/ha) | Total<br>(man-day)             | Unit Rate<br>(pair-day/ha)    | Total<br>(pair-day) |
| <b>Kharif-1 Season</b>                  |                  |                           |                                |                               |                     |
| B. Aus:LV                               | 8,630            | 138                       | 1,190,900                      | 45                            | 388,400             |
| B. Aus:HYV                              | 4,980            | 144                       | 717,100                        | 45                            | 224,100             |
| T. Aus :LV                              | 3,490            | 154                       | 537,500                        | 47                            | 164,000             |
| T. Aus :HYV (rainfed)                   | 7,310            | 174                       | 1,271,900                      | 47                            | 343,600             |
| B. Aus + Aman                           | 6,060            | 171                       | 1,036,300                      | 44                            | 266,600             |
| B. Aman:LV                              | 8,730            | 108                       | 942,800                        | 44                            | 384,100             |
| Jute                                    | 0                | 215                       | 0                              | 45                            | 0                   |
| Summer Vegetables                       | 40               | 270                       | 10,800                         | 44                            | 1,800               |
| Sub-total                               | 39,240           |                           | 5,707,300                      |                               | 1,772,600           |
| <b>Kharif-2 Season</b>                  |                  |                           |                                |                               |                     |
| T. Aus :HYV (rainfed)                   | 2,060            | 174                       | 358,400                        | 47                            | 96,800              |
| B. Aman:LV                              | 12,470           | 171                       | 2,132,400                      | 44                            | 548,700             |
| T. Aman:LV (deep water)                 | 4,350            | 130                       | 565,500                        | 40                            | 174,000             |
| T. Aman:LV                              | 43,030           | 141                       | 6,067,200                      | 40                            | 1,721,200           |
| T. Aman:HYV (rainfed)                   | 13,830           | 166                       | 2,295,800                      | 43                            | 594,700             |
| Sub-total                               | 75,740           |                           | 11,419,300                     |                               | 3,135,400           |
| <b>Rabi Crops</b>                       |                  |                           |                                |                               |                     |
| Boro:LV                                 | 0                | 118                       | 0                              | 25                            | 0                   |
| Boro:LIV                                | 0                | 205                       | 0                              | 43                            | 0                   |
| Boro:HYV (irrigated)                    | 68,400           | 210                       | 14,364,000                     | 43                            | 2,941,200           |
| Wheat (rainfed)                         | 160              | 102                       | 16,300                         | 45                            | 7,200               |
| Pulses                                  | 9,220            | 50                        | 461,000                        | 30                            | 276,600             |
| Oilseeds                                | 1,820            | 58                        | 105,600                        | 37                            | 67,300              |
| Potato (rainfed)                        | 310              | 175                       | 54,300                         | 44                            | 13,600              |
| Winter Vegetables                       | 790              | 270                       | 213,300                        | 44                            | 34,800              |
| Spices                                  | 3,510            | 257                       | 902,100                        | 30                            | 105,300             |
| Sub-total                               | 84,210           |                           | 16,116,600                     |                               | 3,446,000           |
| Grand Total                             | 199,190          |                           | 33,243,200                     |                               | 8,354,000           |
| Ratio to availability                   |                  |                           | 15%                            |                               | 43%                 |
| Availability                            |                  | (2023)                    | 224,285,000                    | (1983-84)                     | 19,625,000          |
| <b>Availability of Labours</b>          |                  |                           |                                |                               |                     |
| 1. Population                           | in 1993          | 2,312,100                 | persons                        |                               |                     |
|   | in 2023          | 3,624,800                 | persons                        |                               |                     |
| 2. Labour availability                  |                  | 33%                       |                                |                               |                     |
| 3. Availability for agriculture         |                  | 75%                       |                                |                               |                     |
| 4. Available number for agriculture     | in 1993          | 572,245                   | adult equivalent               |                               |                     |
|   | in 2023          | 897,138                   | adult equivalent               |                               |                     |
| 5. Annual working days                  |                  | 250                       | days                           |                               |                     |
| 6. Annual available number              | in 1993          | 143,061,000               | man-days                       |                               |                     |
|   | in 2023          | 224,285,000               | man-days                       |                               |                     |
| <b>Availability of Draught Animals</b>  |                  |                           |                                |                               |                     |
| 1. Population                           |                  | 230,900                   | heads adult bullock equivalent |                               |                     |
|   |                  | 115,500                   | pairs approximately            |                               |                     |
| 2. Work efficiency due to age structure |                  | 68%                       |                                |                               |                     |
| 3. Availability for agriculture         |                  | 100%                      |                                |                               |                     |
| 4. Available number for agriculture     |                  | 78,500                    | adult pair equivalent          |                               |                     |
| 5. Annual working days                  |                  | 250                       | days                           |                               |                     |
| 6. Annual available number              |                  | 19,625,000                | pair days                      |                               |                     |

TABLE E.5.2

Balance of Labour Force in the Noakhali North Project Area

1. ANNUAL BALANCE

1.1 Annual Requirement

- Total requirement under future with project condition [FW] : 33,200,000 man-days

1.2 Annual Availability

- Total population in the area : 1991 2,310,000  
2023 3,620,000

- Condition of Calculation

Population availability for labour : 33% of total population

Labour availability for agriculture : 75% of total available labour

Working days : 250 days/year

- draught power availability : 1993  $2,310,000 \times 33\% \times 75\% \times 250 \text{ days} = \underline{143,000,000 \text{ man-day}}$   
2023  $3,620,000 \times 33\% \times 75\% \times 250 \text{ days} = \underline{224,000,000 \text{ man-day}}$

1.3 Balance of Requirement and Available Labour

- in 1993 Availability (143,000,000) - Requirement (33,200,000) = 109,800,000 man-days of surplus,  
(77% of total labour is surplus)
- in 2023 Availability (224,000,000) - Requirement (33,200,000) = 190,800,000 man-days of surplus,  
(85% of total labour is surplus)

2 BALANCE AT PEAK REQUIREMENT (HYV boro, largest crop area in 63% of the project area)

2.1 Peak Requirement of Labour Force

- HYV boro in 68,400 ha under future with project condition [FW]

- Peak unit labour requirement : 2.576 man-day/ha/day in 1st decade of January

- Total requirement in the project area :  $68,400 \text{ ha} \times 2.576 \text{ men-days/ha/day} = \underline{176,200 \text{ men-days}}$

2.2 Availability of Labour Force

- Total population in the area : 1991 2,310,000  
2023 3,620,000

- Condition of calculation

Population availability for labour : 33% of total population

Labour availability for agriculture : 75% of total available labour

Working days : 250 days/year = 68%

- Total labour available per day in 1993  $2,310,000 \times 33\% \times 75\% \times 68\% = \underline{388,800 \text{ man-days/ha}}$   
2023  $3,620,000 \times 33\% \times 75\% \times 68\% = \underline{609,200 \text{ man-days/ha}}$

2.3 Balance of Requirement and Available Labour for HYV Boro

- Balance (1993) in 1st peak : Availability (388,800) - Requirement (176,200) = 212,600 of surplus
- Balance (2023) in 1st peak : Availability (609,200) - Requirement (176,200) = 433,000 of surplus



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TABLE E.5.3

**Balance of Draught Animal in the Noakhali North Project Area**

**1. ANNUAL BALANCE**

**1.1 Annual Requirement**

-Total requirement under future with project condition [FW] : 8,350,000 pair-days

**1.2 Annual Availability**

- Total number of draught animal available in the area :

231,000 heads (draught animal) = 115,500 pairs

- Condition of calculation

Work efficiency : 68%\* of a adult pair equivalent on average,

\*: Working life span of 20 years, idle in age 1 - 2 years, 50% ability in age 3 years, 75% ability in 4 years, 100% ability in 4 - 10 years, 75% ability in 11 to 15 years, 50% ability in 16 - 20 years.

Working days :250 days/year (F/S report in 1990)

- draught power availability : 115,500 pairs x 68% x 250 days = 19,630,000 pairs/day

**1.3 Balance of Draught Animal**

- Availability (19,630,000) - Requirement (8,350,000) = 11,280,000 pairs/days (57%) of surplus,

**2 BALANCE AT PEAK REQUIREMENT (HYV boro, largest crop area in 63% of the area)**

**2.1 Requirement of Draught Animal**

- HYV boro in 68,400 ha under future with project condition [FW]

|                           |          |  |
|---------------------------|----------|--|
| - Unit requirement :      | 1st peak | <u>0.845 pair/day/ha</u> in 3rd decade of Dec. to 1st decade of Jan. |
| based on cropping pattern | 2nd peak | <u>0.725 pair/day/ha</u> in 2nd and 3rd decade of Jan.               |

|                       |          |   |
|-----------------------|----------|---|
| - Total requirement : | 1st peak | 68,400 ha x 0.845 pair/day/ha = <u>57,800 pairs/day</u> |
| in the area           | 2nd peak | 68,400 ha x 0.725 pair/day/ha = <u>49,600 pairs/day</u> |

**2.2 Availability of Draught**

- Total number of draught animal available in the area :

231,000 heads (draught animal) = 115,500 pairs

- Condition for calculation

Work efficiency : 68% of a adult pair equivalent on average (refer to section 1.2 on the above)

Working days :250 days/year = 68% (F/S report in 1990)

- draught power availability : 115,500 pairs x 68% x 68% = 53,400 pairs/day

**2.3 Balance of Draught Animal for HYV Boro**

- Balance

1st peak : Availability (53,400) - Requirement (57,800) = 4,400 pairs/day of shortage

2nd peak : Availability (53,400) - Requirement (49,600) = 3,800 pairs/day of shortage

- Shortage of draught animal

1st peak : (4,400 of adults pair equivalent) ÷ 68% ÷ 68% = 9,500 pairs or 19,000 heads

### E.5.1.2 Draught Animals

The requirement of draught animal for the proposed cropping pattern is examined through balancing the availability in the project area used in the census data in 1983/84, since no data is available to estimate the present and future availability of draught animals. Requirement of draught animal on adult equivalent basis is calculated at 8.35 million pair-days per annum. Availability of draught animals for agriculture in the project area is estimated at 19.6 million pair-days per annum. The ratio of requirement to availability is 43% in annual basis. In term of the peak requirement which occurs in late December to early January, available draught animals of 53,400 pairs/day would not be enough to supply the peak requirement of 57,800 pairs/day for HYV boro on 68,400 ha. The situation of shortage in availability will continue to the end of January.

The results show that some measures would be necessary to supplement short age of draught animals with the future cropping pattern. It is considered that draught animals could not increase due to shortage of feed supply and limited grazing land. In this regard, diversification of draft power from single main source of draught animals will be required through expansion of power tillers in the light of the present situation. This already seems to be happening and continued growth in supply of power tillers is expected now that the import and supply of these through the private sector is less restricted.

### E.5.2 Crop Inputs

Crop input supply is unlikely to be a constraint in the future. Distribution of inputs is now the responsibility of the private sector and there is evidence that the cost of distribution has fallen since deregulation which has helped offset the price increases in fertiliser. Input use by farmers is also not expected to restrict production unless commodity prices fall. In late 1992, there was a dramatic collapse in rice prices (which are not included in this study) caused by an exceptionally good aman harvest. Should prices fail to recover then input use may will decline until such time as shortages increase prices once again. Despite increases in fertiliser prices, fertiliser use has increased, despite the lack of formal credit. There is no evidence from the surveys that small or marginal farmers lack resources. In fact they use the same, if not more, fertiliser than other farmers and get similar yields.

### E.5.3 Future Credit Availability and Requirements.

Future development of all tertiary level irrigation including LLPs and force-mode tubewells is being supported by the National Minor Irrigation Project. However this project does not have a credit component beyond the funding of equipment importers and dealers/contractors. There was provision for lending to farmers for irrigation equipment in the proposed Agricultural and Rural Credit Project II (IDA/ADB/USAID), but this project has been indefinitely postponed pending a reforms of the institutions involved. However the problem in lending is not the availability of funds (banks are awash with cash), but rather in the delivery and recovery systems, which is dependant on major institutional reforms of the banking system and on changing the attitudes of borrowers towards loan repayment.

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Investment by farmers in LLP to utilise improved surface water supplies developed by projects in the region need not be dependant on improvements in the availability of institutional credit. Rapid development of LLPs and STW has already taken place without a major recourse to bank credit. In fact the problems that farmers perceive in getting access to bank credit suggests they would normally prefer to fund this investment from their savings.

Investment in shallows FMTWs, that may provide an alternative to surface water in areas where conditions preclude STWs, is more problematic. Although their overall cost per hectare irrigated is competitive with STW, because relatively high capital costs are offset by greater operating efficiency, they do demand a larger investment. This means they are less easily affordable and the investment will be seen as a considerable risk, especially as they are a relatively untried technology in Bangladesh to date. This may mean that uptake of this technology is relatively slow. However in a survey of 92 STW operators,<sup>1</sup> over half said they were interested in purchasing FMTW. Almost half of the potential investors said they would use their own savings rather needing a bank loan.

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<sup>1</sup> 1) DTW Final Report Credit Study.



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**APPENDIX E.I**  
**AGRO-ECONOMIC SURVEYS**

## APPENDIX E.I

### AGRO-ECONOMIC SURVEYS

#### E.I.1 General

The following surveys were conducted in each of the agro-ecological Zones A, B, C and D:

| Surveys           | Respondents (Number) |    |    |     | Total Respondents |
|-------------------|----------------------|----|----|-----|-------------------|
|                   | A                    | B  | C  | D   |                   |
| Farmer            | 96                   | 96 | 96 | 96  | 384               |
| Farmer Case Study | 12                   | 12 | 12 | 14  | 50                |
| Landless          | 24                   | 24 | 24 | 24  | 96                |
| Capture Fishermen | 20                   | 20 | 20 | 20  | 80                |
| Culture Fishermen | 24                   | 24 | 24 | 24  | 96                |
| Women             | 24                   | 24 | 24 | 24  | 96                |
| Plot              | 60                   | 60 | 60 | 120 | 300               |
| Irrigation Pump   | 24                   | 24 | 24 | 24  | 96                |

The objective and methodology of the agro-economic surveys were described in the Inception Report. By and large, the surveys have produced reasonable results in the sense that they are not at variance widely with those of secondary data sources. However, it is of note that more confidence can be attached to the results of yes/no, what crops are grown type of questions than those requiring quantification such as a yield. This is specially true in respect of answers given for small areas such as farm plots where even a relatively small over or under estimation gives rise to greatly magnified figures as a result of conversion into bigger units like tonnes and hectares. For instance, a one maund error on a 20 decimal plot becomes a 450 per hectare error on conversion.

In deference to the standard practice, we have in this study, classified the farmers into the following groups:

| Farm-groups | Farm Land Holding (Hectare) |
|-------------|-----------------------------|
| Large       | 3 +                         |
| Medium      | 1.0 to 3.0                  |
| Small       | 0.2 to 1.0                  |
| Marginal    | .02 to 0.2                  |

### E.I.2. Ownership, Fragmentation and Land-Tenure

The farmer survey cannot be used to describe Land-ownership pattern because it presupposed the structures by determining the numbers of farms in each farm-size (marginal, small, medium and large) for inclusion in the sample. This information has been obtained from an analysis of a large number of entries on the tax-lists for each Zone from which the sample was drawn and the results have been checked against previous studies and other secondary data. The methodology adopted has been to assess the proportions of landless, marginal, small, medium and large farmers from the lists and then use these results in conjunction with the average holding sizes obtained from the survey to derive ownership and farm-size structures presented in Table below.

TABLE E.I.1

Pattern of Land Ownership by Farm Land

| Farm-Size | Percentage of Holding |      |      |      | Overall Percentage by |               |
|-----------|-----------------------|------|------|------|-----------------------|---------------|
|           | A                     | B    | C    | D    | Area                  | Nos. of Farms |
| Large     | 21.7                  | 18.6 | 10.3 | 12.3 | 16.2                  | 2.9           |
| Medium    | 34.4                  | 28.8 | 45.0 | 48.5 | 38.3                  | 14.0          |
| Small     | 40.1                  | 46.0 | 39.1 | 34.7 | 40.4                  | 55.2          |
| Marginal  | 3.8                   | 6.6  | 5.6  | 4.5  | 5.1                   | 27.9          |

Source: Estimated by applying average holding size obtained from the survey to farm household distribution obtained from tax-list.

Ownership of land presents a highly Skewed picture as was expected. Small and marginal farmers who constitute 81 to 85 percents of the farm households in different Zones own about 40 to 50 percent of the farm-land across the Zones. The 1983-84 Agricultural Census reports similar results for the erstwhile Noakhali district as a whole. The average weighted average size holding has been found to be 0.81 hectare against 0.91 hectare for Bangladesh recorded by Agricultural census.

As regards fragmentation, the survey records 5.03 as the average number of fragments per hectare against about 6 fragments per hectare for Bangladesh (Boyce, J.K. 1987). The distribution of farm land holding across the flood-phases indicates that they are concentrated in fewer flood-phases. On the whole 58 percent of the farmers have plots in one flood phase and another 38 percent in two flood-phases. This jeopardises the widely held view that farmers endeavour to farm land across a range of flood phases in order to spread the risk. The survey also brings to book a positive association between the dispersion of land holding and farm-size.



TABLE E.I.2

Dispersion of Plots by Flood Phase (Percent of Respondent)

| Farm-groups | Holdings in Flood-Phases |      |       |      |
|-------------|--------------------------|------|-------|------|
|             | One                      | Two  | Three | Four |
| Marginal    | 78.3                     | 21.7 | -     | -    |
| Small       | 58.9                     | 38.4 | 2.7   | -    |
| Medium      | 41.0                     | 50.6 | 8.4   | -    |
| Large       | 40.0                     | 30.0 | 30.0  | -    |
| Overall     | 58.0                     | 37.8 | 4.2   | -    |

Commensurate to the highly skewed land-ownership, the area is found to be characterised by a high degree of tenancy with about 16.0 percent of the farmland under tenurial arrangement, measured as the ratio of tenanted in area to the total cultivated area. The extent of tenancy for Bangladesh is found to be similar. Share cropping, accounting nearly 92 percent of the tenanted land, is the pre-dominant mode of tenancy. Different Zones are alike in this regard. Areas rented or Share cropped out are much higher, by about 117 percent, than those rented or share cropped in. The main reason for this is that many farmers own land in the 'char' areas which are outside the project area and which are generally operated by other people who also resides outside the project area.

### E.I.3 Cropping Pattern and Cropping Intensity

Cropping pattern by flood-phases summarised in the table below, would convey better insights into the relationship between the crops grown and the physical condition of land than that by any other characteristics. This is supplemented by another table, containing a description of the various crops grown in different Zones, for an overview of the cropping pattern as well as cropping intensity across the Zones.

TABLE E.I.3

Land Use (Area in Hectare)

|          | Total<br>owned<br>Land | Area not<br>cultivated | Owned<br>cultivated<br>land | Area<br>Rented<br>out | Area<br>Sharecropped<br>out | Are<br>Mortgaged<br>out | Are<br>Rented<br>in | Area<br>Sharecropped<br>in | Are<br>Mortgged<br>in | Total<br>Cultiva-<br>ted land |
|----------|------------------------|------------------------|-----------------------------|-----------------------|-----------------------------|-------------------------|---------------------|----------------------------|-----------------------|-------------------------------|
| Zone A   |                        |                        |                             |                       |                             |                         |                     |                            |                       |                               |
| Marginal | 28.908                 | 130.860                | 15.048                      |                       |                             |                         |                     | 1.229                      |                       | 16.277                        |
| Small    | 202.752                | 42.624                 | 160.128                     | .168                  | 40.320                      | 1.445                   |                     | 33.120                     |                       | 151.315                       |
| Medium   | 153.600                | 15.936                 | 137.600                     |                       | 49.157                      |                         |                     | 28.629                     |                       | 117.072                       |
| Large    | 92.180                 | 5.192                  | 86.988                      |                       | 38.412                      |                         |                     | 14.696                     |                       | 63.272                        |
| Total    | 477.44                 | 77.612                 | 399.764                     | 0.168                 | 127.889                     | 1.445                   |                     | 77.674                     |                       | 347.936                       |
| Zone B   |                        |                        |                             |                       |                             |                         |                     |                            |                       |                               |
| Marginal | 53.238                 | 26.790                 | 26.448                      |                       | 10.659                      |                         |                     | 1.231                      |                       | 17.020                        |
| Small    | 228.718                | 43.316                 | 185.640                     |                       | 83.476                      |                         |                     | 23.866                     |                       | 126.03                        |
| Medium   | 142.080                | 25.980                 | 116.100                     | 4.800                 | 27.243                      |                         | 1.389               | 15.840                     |                       | 101.286                       |
| Large    | 93.495                 | 18.630                 | 74.865                      |                       |                             |                         |                     |                            |                       | 74.865                        |
| Total    | 517.531                | 114.716                | 403.053                     | 4.800                 | 121.378                     |                         | 1.389               | 40.937                     |                       | 318.201                       |
| Zone C   |                        |                        |                             |                       |                             |                         |                     |                            |                       |                               |
| Marginal | 27.383                 | 10.008                 | 17.375                      |                       | 0.801                       |                         | .159                | 1.443                      |                       | 18.176                        |
| Small    | 156.160                | 34.648                 | 121.756                     |                       | 26.480                      |                         | 3.315               | 18.710                     | 1.897                 | 119.198                       |
| Medium   | 153.104                | 13.104                 | 140.00                      | 3.260                 | 41.564                      |                         |                     | .979                       |                       | 96.155                        |
| Large    | 35.298                 | 3.402                  | 31.896                      |                       | 1.884                       |                         |                     |                            |                       | 30.012                        |
| Total    | 371.945                | 61.162                 | 311.027                     | 3.260                 | 70.729                      |                         | 3.474               | 21.132                     | 1.897                 | 263.541                       |
| Zone D   |                        |                        |                             |                       |                             |                         |                     |                            |                       |                               |
| Marginal | 24.087                 | 9.435                  | 14.652                      |                       | 4.373                       |                         |                     | 2.96                       | 3.293                 | 16.532                        |
| Small    | 140.315                | 27.852                 | 112.463                     | 5.461                 | 21.947                      | .336                    | 3.923               | 26.057                     | .671                  | 115.370                       |
| Medium   | 175.440                | 18.292                 | 157.148                     |                       | 32.912                      | 1.836                   |                     | 6.664                      |                       | 129.064                       |
| Large    | 41.958                 | 2.259                  | 39.699                      |                       | 4.374                       |                         |                     |                            |                       | 35.325                        |
| Total    | 381.800                | 57.838                 | 323.962                     | 5.461                 | 63.606                      | 2.172                   | 3.923               | 35.681                     | 3.964                 | 296.291                       |

Source: Estimated by applying average holding/transaction size obtained from the survey to the farm household distribution obtained from tax-list.

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TABLE E.1.4

## Dominant Cropping Pattern by Flood-Phase

| Cropping Pattern                                  | F <sub>0</sub> |                         | F <sub>1</sub> |                         | F <sub>2</sub> |                         | F <sub>3</sub> |                         |
|---|----------------|-------------------------|----------------|-------------------------|----------------|-------------------------|----------------|-------------------------|
|   | Rank           | % of total cropped area | Rank           | % of total cropped area | Rank           | % of total cropped area | Rank           | % of total cropped area |
| t. aman (L/I)                                     | 1              | 28.18                   | 3              | 6.15                    |                |                         |                |                         |
| b. aus (L) - t. aman (L/I) - chilli               | 3              | 8.55                    | 4              | 5.52                    |                |                         |                |                         |
| t. aman (L/I) - boro                              |                |                         | 2              | 8.84                    | 5              | 5.11                    |                |                         |
| b. aus (L) - t. aman (L/I)                        |                |                         | 1              | 9.98                    | 7              | 3.91                    |                |                         |
| T. aus (HYV) - boro                               |                |                         | 12             | 2.42                    | 4              | 5.43                    |                |                         |
| - - - boro  |                |                         |                |                         | 2              | 16.90                   | 2              | 28.94                   |
| mixed b. aus & aman                               |                |                         |                |                         | 6              | 3.98                    | 5              | 5.38                    |
| mixed b. aus & aman - boro                        |                |                         |                |                         | 3              | 6.64                    | 4              | 7.04                    |
| d.w. b. aman - boro                               |                |                         |                |                         | 1              | 35.34                   | 1              | 40.13                   |
| Jute - t. aman (L/I) - pulses                     | 4              | 4.76                    |                |                         |                |                         |                |                         |
| - - - chilli                                      | 6              | 3.32                    |                |                         |                |                         |                |                         |
| betle nut - - -                                   | 2              | 12.76                   |                |                         |                |                         |                |                         |
| banana - - -                                      | 5              | 4.44                    |                |                         |                |                         |                |                         |
| b. aus (L) - t. aman (L/I) - boro                 |                |                         | 8              | 3.63                    |                |                         |                |                         |
| t. aus (L) - t. aman (L/I) -                      |                |                         | 6              | 3.89                    |                |                         |                |                         |
| t. aus (L) - t. aman (L/I) - boro                 |                |                         | 11             | 2.58                    |                |                         |                |                         |
| t. aus (HYV) - t. aman (L/I)                      |                |                         | 5              | 4.46                    |                |                         |                |                         |
| t. aus (HYV) - t. aman (L/I)-pulses               |                |                         | 7              | 3.86                    |                |                         |                |                         |
| b. aus (HYV) - t. aman (L/I)                      |                |                         | 9              | 2.95                    |                |                         |                |                         |
| b. aus (HYV) - t. aman (L/I) - boro               |                |                         | 10             | 2.87                    |                |                         |                |                         |
| t. aus (HYV) - t. aman (L/I) - oil seed           |                |                         | 13             | 2.14                    |                |                         |                |                         |
| d.w. b. aman                                      |                |                         |                |                         |                |                         | 3              | 11.26                   |
| No. of cropping pattern & percent of cropped area | 6              | 62.3                    | 13             | 59.3                    | 7              | 77.3                    | 5              | 92.8                    |

Note: L/I means local/local improved variety; Boro are HYV.



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TABLE E.I.5

Area Under Different Crops in Zone A, B, C, and D

| Crops             | Zone: A              |      | Zone: B              |      | Zone: C              |      | Zone: D              |      |
|-------------------|----------------------|------|----------------------|------|----------------------|------|----------------------|------|
| Crops             | Area (Ha)<br>= 97.43 | %    | Area (Ha)<br>= 70.26 | %    | Area (Ha)<br>= 71.27 | %    | Area (Ha)<br>= 77.58 | %    |
| B. Aus (LV)       | 25.39                | 26.1 | 3.57                 | 5.0  | 10.37                | 14.5 | 2.68                 | 3.4  |
| (HYV)             | 15.34                | 15.7 | .38                  | .5   | 3.35                 | 4.7  | .37                  | .4   |
| T. Aus (LV)       | 1.25                 | 1.3  | 8.43                 | 11.6 | 3.05                 | 4.3  | .26                  | .3   |
| (HYV)             | 2.96                 | 3.0  | 8.87                 | 12.6 | 6.46                 | 9.0  | 6.15                 | 7.9  |
| B. Aus + Aman     | .72                  | 0.7  | 11.34                | 16.1 | 4.88                 | 6.8  | 5.80                 | 7.4  |
| B. Aman (LV) d.w. | 1.15                 | 1.2  | -                    | -    | 12.23                | 17.1 | 41.61                | 53.6 |
| T. Aman (LV) d.w. | -                    | -    | .22                  | 0.3  | 3.09                 | 4.3  | .18                  | .2   |
| T. Aman (LV/LIV)  | 69.84                | 71.7 | 27.18                | 38.6 | 29.70                | 41.6 | 2.11                 | 2.7  |
| (HYV)             | 18.02                | 18.5 | 2.12                 | 3.0  | 2.06                 | 2.9  | 1.24                 | 1.6  |
| Boro (LV)         | .81                  | 0.8  | -                    | -    | -                    | -    | .12                  | .1   |
| (LIV)             | -                    | -    | -                    | -    | -                    | -    | -                    | -    |
| (HYV)             | 18.11                | 18.6 | 44.89                | 63.9 | 39.60                | 55.5 | 56.27                | 72.5 |
| Wheat (LV)        | .24                  | 0.3  | -                    | -    | .12                  | 0.1  | -                    | -    |
| (HYV)             | .22                  | 0.2  | -                    | -    | -                    | -    | -                    | -    |
| Jute              | -                    | -    | 0.12                 | 0.2  | .97                  | 1.3  | .91                  | 1.4  |
| Pulses            | 9.6                  | 9.9  | .51                  | 0.7  | 1.74                 | 2.4  | 1.01                 | 1.3  |
| Oilseeds          | 4.05                 | 4.2  | .10                  | 0.1  | .10                  | 0.1  | .03                  | .4   |
| Potato            | .73                  | 0.8  | .11                  | 0.1  | .11                  | .2   | .05                  | .6   |
| Taro              | .81                  | 0.8  | .06                  | 0.9  | .09                  | 1.3  | .09                  | 1.1  |
| Winter Veg.       | .27                  | 0.3  | .32                  | 0.5  | .48                  | .6   | .13                  | 1.7  |
| Summer Veg.       | -                    | -    | -                    | -    | 0.1                  | .1   | -                    | -    |
| Betel nut         | .59                  | 0.6  | .11                  | 0.1  | 2.03                 | 2.8  | 1.08                 | 1.4  |
| Banana            | 1.13                 | 1.2  | -                    | -    | -                    | -    | -                    | -    |
| Spices            | 7.49                 | 7.7  | 1.68                 | 2.4  | 2.21                 | 3.1  | 1.12                 | 1.4  |
| Tree crop/fruit   | .34                  | 0.4  | .26                  | 0.4  | .33                  | .5   | .28                  | .3   |
| Others            | .28                  | 0.3  | .08                  | 0.1  | .11                  | .1   | .97                  | 1.2  |
| All               | 179.34               | 184  | 110.35               | 157  | 123.09               | 173  | 122.46               | 158  |

Cropping Intensity by other Sources.

|     |           |     |     |     |     |
|-----|-----------|-----|-----|-----|-----|
| BBS | 1991      | 121 | 153 | 150 | 148 |
|     | 1992      | 120 | 153 | 148 | 140 |
| DAE | 1991/1992 | 144 | 133 | 144 | -   |

Farmers reported as many as 47, 124, 45 and 13 cropping patterns respectively in F<sub>0</sub>, F<sub>1</sub>, F<sub>2</sub> and F<sub>3</sub> lands. But it can be seen from the table that only a few of them account for the major share of the cropped area in Zones A, B and C and over 90 percent in Zone D. It should be mentioned that these cropping patterns refer to a single year and some of these, like aus-aman-boro or d.w. aman-boro, may not be repeatable in two successive years because following boro it would be late or inconvenient to grow aus or d.w.aman. However, area under such cropping patterns are rather small and would not distort the general pattern observed.

It is seen that barring the annual/perennial crops all the cropping patterns save one are based on rice or have rice in common with other crops. Thus it is no surprising that rice occupies about 95 percent of the cropped area in B, C and D Zones and 85 percent of the cropped area in Zone A.

Overall, aman is the most important cereal in terms of acreage, followed by boro and aus although the order of importance changes as between the Zones. Of the remaining crops, mention can be made of spices, pulses and to some extent oilseeds which together accounts for about 12 percent of the cropped area in Zone A. Excepting spices and betel nut in Zone C, the area under these two being 6.0 percent of the cropped area, non-cereal crops are of little or no significance in B, C and D Zones.

Cropping intensities recorded by the survey along with those calculated from the BBS and DAE cropped areas are contained in table E.I.5. The highest intensity of 184 is noted for Zone A followed by 173 in Zone C and about 158 in B and D. The DAE and BBS figures, compared with those of the survey ones, indicate lower intensities in all the Zones. However, excepting in Zone A, the discrepancies are rather small. Plausible explanations for these variations could be found in the methodological differences: Survey data relate to the project area which is composed of some fractions of the areas of the thanas involved; whereas DAE and BBS data refer to the overall areas of the thanas involved. Thus for example unlike the survey, DAE & BBS includes 'char' lands which are less intensively farmed.

A more detailed description of cropping intensities is presented in table E.I.6.

TABLE E.I.6

Survey Cropping Intensities

|                  |    | Zone |     |     |     |     |
|------------------|----|------|-----|-----|-----|-----|
|                  |    | All  | A   | B   | C   | D   |
| Overall          |    | 171  | 188 | 157 | 174 | 158 |
| Marginal Farmers |    | 172  | 225 | 144 | 173 | 172 |
| Small Farmers    |    | 184  | 209 | 162 | 196 | 173 |
| Medium Farmers   |    | 169  | 195 | 159 | 172 | 143 |
| Large Farmers    |    | 140  | 147 | 100 | 127 | 156 |
| Flood Phase:     | 0  | 130  | 137 | 100 | 129 | 104 |
|                  | 1  | 191  | 196 | 193 | 186 | 158 |
|                  | 2  | 161  | 168 | 147 | 175 | 162 |
|                  | 3+ | 135  | 100 | 100 | 169 | 147 |

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In general, the cropping intensities have turned out as expected. Small (and to a lesser extent marginal) farmers crop their lands more intensively than larger farmers and also less flood-prone land, with the exception of F<sub>0</sub> land, is more intensively farmed than more deeply flooded land. The F<sub>0</sub> land which registers a relatively low cropping intensity has a larger share of area under annual and perennial crops. Sugarcane, banana betel nut, coconut and other tree crop/fruit account for about 20 percent of the cropped area in F<sub>0</sub> land against less than 1.0 percent area under these crops in other flood phases.

#### E.I.4 Irrigation

Data on irrigation, the leading input, is presented Table E.I.7. The table reveals that cent per cent boro land is irrigated in all zones and by all farm sizes. However, small and marginal farmers cultivate boro to a much higher proportion of their land than do the large farmers. Regarding irrigation in other seasons, rabi crops do have sizeable irrigation excepting in Zone A. Large farmers particularly are poor performers in respect of irrigation of rabi crops. Aus crop also has some irrigation and aman least irrigation. Coming to the source of irrigation, LLP covers over 90 percent of total irrigation. Traditional irrigation ranks second. Others appear to be of little importance.

#### E.I.5 Crop Yields

Survey crop yields are presented in Table E.I.8. Yield data for some of the crops which are not adequately represented are also included keeping in mind the sampled area in question. In general, crop yields exhibit large variations when the data is disaggregated by either flood-phase or farm-size. Large variations occur particularly when the data is disadvantaged by small sample sizes e.g. B. Aus (HYV) and T. Aus (HYV), Potato (HYV) in F<sub>0</sub>, mixed vegetables in F<sub>2</sub> etc. Larger farmers turn out to be better performers in the case of high value, high input using crop like Boro (HYV). Unlike cropping intensities, yield data are vulnerable to weather conditions like flood, drought, hailstorm etc. As such crop yields from a single year are generally less satisfactory as a basis for long term predictions. For these reasons, other available yield data will be considered along with survey yields to formulate project yields.

#### E.I.6 Summary Farmer Survey Indicators

The outcome of an intervention with regard to water resource development would call for an examination of some factors which might restrict or delay the achievement of increased agricultural production. These factors are, inter alia, shortage of inputs like labour, draft power, irrigation, fertiliser, credit, poor access to markets, lack of extension services etc.



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TABLE E.I.7

Irrigation Coverage (%)

|          | A    |      | B    |      | C    |      | D    |      |
|----------|------|------|------|------|------|------|------|------|
|          | Rabi | Boro | Rabi | Boro | Rabi | Boro | Rabi | Boro |
| Marginal | -    | 100  | 37.5 | 100  | 27.8 | 100  | -    | 100  |
| Small    | 8.3  | 100  | 18.6 | 100  | 22.5 | 100  | 11.0 | 100  |
| Medium   | 5.6  | 100  | 43.8 | 100  | 14.7 | 100  | 50.0 | 100  |
| Large    | -    | 100  | -    | 100  | -    | 100  | 4.7  | 100  |

Percent Coverage of Irrigated Boro (1)

|          | A    | B    | C    | D    |
|----------|------|------|------|------|
| Marginal | 25.5 | 68.8 | 76.6 | 85.0 |
| Small    | 25.8 | 69.9 | 67.2 | 82.3 |
| Medium   | 25.1 | 55.3 | 43.9 | 65.3 |
| Large    | -    | 14.2 | 57.3 | 60.0 |

Percent of Irrigation Coverage

|      | A     | B     | C     | D     |
|------|-------|-------|-------|-------|
| Aus  | 2.6   | 6.9   | 5.3   | -     |
| Aman | -     | 1.2   | 1.2   | -     |
| Rabi | 4.8   | 35.4  | 23.6  | 18.6  |
| Boro | 100.0 | 100.0 | 100.0 | 100.0 |

Percent Source of Irrigation \*

|             | A    | B    | C    | D    |
|-------------|------|------|------|------|
| STW         | -    | -    | 0.5  | -    |
| LLP         | 95.7 | 90.2 | 92.1 | 94.4 |
| DTW         | -    | -    | 6.6  | 2.0  |
| Manual TW   | -    | -    | -    | -    |
| Traditional | 4.3  | 9.8  | 0.8  | 3.6  |
| Overall (1) | 19.4 | 64.0 | 55.5 | 72.7 |

\* Calculated as the ratio of area irrigated by the source to the total irrigated area.

**TABLE E.I.8**  
**Average Yield (t/ha)**

| Crops Name           | Yield        |             |             |             | Yield       |             |             |             | Yield        |               | Total       |
|----------------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|---------------|-------------|
|                      | PO           | F1          | F2          | F3          | Marginal    | Small       | Medium      | Large       | Irrigation   | No Irrigation | Yield       |
|                      | (t/ha)       | (t/ha)      | (t/ha)      | (t/ha)      | (t/ha)      | (t/ha)      | (t/ha)      | (t/ha)      | (t/ha)       | (t/ha)        | (t/ha)      |
| <b>Season: Aus</b>   |              |             |             |             |             |             |             |             |              |               |             |
| B. Aus Local         | 1.78         | 1.74        | 1.04        |             | 2.54        | 1.44        | 1.68        | 1.30        |              | 1.56          | 1.56        |
| B. Aus HYV           | 3.89         | 2.67        | 1.86        |             | 3.29        | 2.22        | 2.71        | 2.02        |              | 2.60          | 2.60        |
| T. Aus Local         |              | 1.93        | 2.13        |             | 1.09        | 2.13        | 1.84        | 2.15        | 2.07         | 1.97          | 2.00        |
| T. Aus HYV           | 1.73         | 2.70        | 2.64        |             | 3.03        | 2.50        | 3.18        | 2.44        | 2.50         | 2.69          | 2.66        |
| M.B. Aus & B.Aman    |              | 2.63        | 2.36        | .79         | 2.63        | 2.15        | 2.51        |             |              | 2.29          | 2.29        |
| B. Aman Local (d.w.) |              | 1.32        | .69         | .63         | .69         | .81         | .54         | .37         |              | .71           | .71         |
| T. Aman Local (d.w.) |              | 1.47        | 1.69        | 1.63        | 1.55        | 1.36        | 3.41        |             | 3.91         | 1.44          | 1.62        |
| Groundnut            | .15          |             |             |             |             | .15         |             |             |              | .15           | .15         |
| Jute desi/mesta      | 1.76         | 1.70        | 1.27        |             | 1.20        | 1.65        | 1.52        | 1.23        |              | 1.50          | 1.50        |
| Jute Tosta           |              | 2.00        | 1.54        |             |             | 1.54        | 2.00        |             |              | 1.77          | 1.77        |
| Taro-ekko            | 3.07         | 7.68        |             |             | 7.68        | 3.07        |             |             | 3.07         | 7.68          | 4.61        |
| Okra                 |              | 2.30        |             |             |             | 2.30        |             |             |              | 2.30          | 2.30        |
| Other/mixed veg      | 3.07         |             |             |             |             | 3.07        |             |             | 3.07         |               | 3.07        |
| Sugarcane            |              |             |             |             |             |             |             |             |              |               |             |
| Beetle nut           | .84          | 1.54        |             | 1.08        | 3.59        | .90         | .78         | .16         |              | .93           | .93         |
| Bamboo               | .49          |             |             |             |             |             |             | .49         |              | .49           | .49         |
| Coconut              | 3.46         |             |             |             |             | 4.61        | 2.30        |             |              | 3.46          | 3.46        |
| <b>Total</b>         | <b>1.71</b>  | <b>2.21</b> | <b>1.45</b> | <b>.71</b>  | <b>2.08</b> | <b>1.65</b> | <b>1.87</b> | <b>.93</b>  | <b>2.43</b>  | <b>1.70</b>   | <b>1.73</b> |
| <b>Season: Aman</b>  |              |             |             |             |             |             |             |             |              |               |             |
| T. Aman Local/LIV    | 1.73         | 2.18        | 1.95        |             | 2.23        | 2.11        | 2.10        | 1.80        | 2.36         | 2.10          | 2.10        |
| T. Aman HYV          | 3.31         | 2.72        | 3.16        |             | 3.03        | 2.53        | 3.12        | 3.03        | 4.41         | 2.82          | 2.87        |
| <b>Total</b>         | <b>2.18</b>  | <b>2.26</b> | <b>2.09</b> |             | <b>2.30</b> | <b>2.16</b> | <b>2.31</b> | <b>1.97</b> | <b>3.90</b>  | <b>2.20</b>   | <b>2.21</b> |
| <b>Season: Rabi</b>  |              |             |             |             |             |             |             |             |              |               |             |
| Wheat Local          | 1.23         | 1.38        |             |             |             |             | 1.31        |             | 1.31         |               | 1.31        |
| Wheat HYV            |              | 1.41        |             |             |             | 1.54        | 1.29        |             | 1.54         | 1.29          | 1.41        |
| Maize                | .76          |             |             |             |             | .76         |             |             |              | .76           | .76         |
| Keshuri (Lathyrus)   | .42          | .56         | .81         |             | .54         | .60         | .46         | .56         |              | .55           | .55         |
| Masur (Lentil)       | .09          | .57         |             | .58         |             | .49         | .50         |             |              | .49           | .49         |
| Chola (chick pea)    | .49          | .08         | 1.38        |             |             | .73         |             | .49         |              | .65           | .65         |
| Mung (green gram)    | .66          | .48         | .46         |             |             | .39         |             | .71         |              | .50           | .50         |
| Mash kalsi (b.gram)  | 8.42         | .21         | .48         |             |             | 4.05        | .56         |             |              | 2.33          | 2.33        |
| Other pulses         | .67          | .49         |             |             |             | .48         | .61         | .26         |              | .53           | .53         |
| Mustard              | .91          | .80         | .77         |             | 1.11        | .65         | .94         |             | 2.15         | .70           | .84         |
| Groundnut            |              | 1.21        |             |             |             | 1.40        | 1.31        | .65         |              | 1.21          | 1.21        |
| Soyabean             |              | 1.42        |             |             |             | 2.30        | 1.31        | .54         |              | 1.42          | 1.42        |
| Potato hyv           | 2.30         | 13.52       | 24.58       |             | 2.30        | 18.86       | 13.67       |             | 19.05        | 10.17         | 14.61       |
| Potato Local         | 23.51        | 24.07       | 38.41       |             | 3.07        | 22.74       | 36.88       |             | 28.60        | 16.52         | 25.58       |
| taro/ekko            | 7.82         | 6.72        | 11.68       |             | 7.30        | 6.56        | 8.97        |             |              | 8.15          | 8.15        |
| Briyal               | 6.82         | 4.80        | 16.13       |             | 4.61        | 5.05        | 9.26        |             | 8.07         | 3.99          | 6.99        |
| Okra                 | 9.22         |             |             |             |             | 9.22        |             |             | 9.22         |               | 9.22        |
| Tomatoes             | 1.54         | 46.10       | 7.68        |             | 1.54        |             | 7.68        | 46.10       | 15.75        |               | 15.75       |
| Gourd/pumpkin/melon  | 3.07         |             |             |             |             | 3.07        |             |             |              | 3.07          | 3.07        |
| Other/mixed veg      | 10.91        | 16.23       | .37         |             | 8.14        | 19.45       | 8.43        |             | 16.50        | 1.35          | 12.37       |
| Onion                | 1.23         | 3.62        | .38         |             |             | 2.90        | .86         |             |              | 2.49          | 2.49        |
| Chilli               | 1.06         | 2.00        | 1.09        | .77         | 1.67        | 1.06        | 2.89        | .59         | 1.08         | 1.76          | 1.63        |
| Garlic               | .80          | 1.45        |             | .38         |             | 1.76        | .77         | .80         | .38          | 1.24          | 1.02        |
| Sugarcane            | 129.38       | 23.05       | 46.10       |             |             | 91.46       |             |             | 253.52       | 50.94         | 91.46       |
| Oth. tree crop/fruit | 19.97        | 6.45        | 5.57        |             |             | 11.00       | 12.44       |             | 23.07        | 6.03          | 11.36       |
| <b>Total</b>         | <b>10.08</b> | <b>3.48</b> | <b>5.48</b> | <b>.38</b>  | <b>2.86</b> | <b>6.55</b> | <b>4.82</b> | <b>2.99</b> | <b>13.74</b> | <b>3.00</b>   | <b>5.41</b> |
| <b>Season: Boro</b>  |              |             |             |             |             |             |             |             |              |               |             |
| Boro Local           |              |             | 1.61        | 1.23        |             |             | 1.42        |             | 1.42         |               | 1.42        |
| Boro HYV             | 3.86         | 4.81        | 5.13        | 5.43        | 4.97        | 4.98        | 5.03        | 5.03        | 5.08         |               | 5.08        |
| <b>Total</b>         | <b>3.86</b>  | <b>4.81</b> | <b>5.13</b> | <b>5.38</b> | <b>4.97</b> | <b>4.98</b> | <b>5.27</b> | <b>5.03</b> | <b>5.07</b>  |               | <b>5.07</b> |

TABLE E.I.9

Summary Farmer Survey Indicators

| % of Respondents Who                             | Zone |     |    |    |
|--|------|-----|----|----|
|  | A    | B   | C  | D  |
| Use animal for land preparation                  | 97   | 62  | 93 | 93 |
| have their own draft animals                     | 34   | 16  | 15 | 35 |
| make some use of power tiller                    | 31   | 58  | 63 | 33 |
| record shortages of draft power                  | 76   | 67  | 76 | 62 |
| employ non-family labour                         | 84   | 74  | 81 | 87 |
| register delays of farm work for labour shortage | 46   | 57  | 51 | 58 |
| register shortage of irrigation water every year | 33   | 42  | 46 | 43 |
| sell most of the products                        | 6    | 2   | 4  | 0  |
| buy the products                                 | 63   | 83  | 70 | 78 |
| use own source to finance fertiliser & pesticide | 92   | 85  | 60 | 67 |
| use own source to finance tubewell/LLP hire      | 100  | 100 | 67 | 73 |
| has regular contact with extension               | 23   | 8   | 0  | 8  |
| Need more advice                                 | 77   | 62  | 67 | 83 |
| happy with normal monsoon flood                  | 79   | 26  | 40 | 14 |
| have sources of income other than farming        | 72   | 91  | 72 | 74 |
| have farming as in aim source of income          | 46   | 58  | 36 | 46 |
| have farming as second source of income.         | 39   | 36  | 51 | 41 |

The majority of the farmers donot own draft animal but most of them use draft animal for land preparation. Thus hiring of draft animal is quite of high degree around 60 percent. The majority of farmers, over 60 percent in B and D and around three-fourth in A and C undergo draft power shortage. This situation is, in part, attributable to the decreasing area under grazing consequent upon the overall increasing pressure of population. Revival of the situation is very unlikely and solution of increased demand has to be sought in increased mechanisation of particularly the operations like ploughing. This process has already made some progress with farmers, over 30 percent in A and D and around 60 percent in B and C, reportedly making use of power tillers.

A very high percentage, over 80 percent, of the farmers make use of hired labour for farm works and the incidence of labour shortage is also high, over 50 percent, causing delay of farm-works. Increased mobility of labour with the development of infrastructure and communication system cannot be the answer to the increased future demand in as much as the shortages are of seasonal types and particularly occur at some peak points of ploughing and harvesting periods. Increased mechanisation of land preparation with mitigate the problem to some extent. Labour shortage for harvesting works should not be of much concern because the shortage on this account is very small, about 4 percent.



Shortage of irrigation water is reported by 36.0 percent respondents in Zone B to about 70 percent in Zone D. Most of this shortage is due to insufficient water in the khals. Poor distribution from pump and particularly maintenance problems of equipments also account for the problem to a high degree. Most respondents are subsistence farmers and the majority of them are not self-sufficient and has to buy different products and inputs. The most critical inputs like hire of tubewell/LLP and procurement of fertiliser and pesticides, are overwhelmingly self-financed.

Farmers' contact with extension people appears to be few and far between and the great majority of them feels the necessity of more contact. Other important features of the survey are the relatively low proportion of the farmers, well below 50 percent, citing farming as their main source of income and a high proportion having other sources of income.

### E.I.7 Flood Damage

The survey data of flood damage to crops is unreliable. Although the area is relatively less flood prone, the 1988 flood has assumed fabulous proportions. The data is more useful in determining the pattern and distribution of damage rather than its overall extent. Data on flood damage to property is easier to interpret and is summarised below:

TABLE E.I.10

#### Damage to Property in 1988 (in Percent of Sample)

|            |              | 1988 |      |      |      |
|------------|--------------|------|------|------|------|
|            |              | A    | B    | C    | D    |
| Housing:   | not damage   | 66.7 | 66.7 | 55.2 | 50.9 |
|            | minor damage | 16.6 | 4.2  | 26.0 | 26.0 |
|            | major damage | 12.5 | 18.7 | 14.6 | 18.7 |
|            | destroyed    | 4.2  | 10.4 | 4.2  | 6.2  |
| Livestock: | no loss      | 25   | 16   | 31   | 29   |
|            | losses       | 75   | 84   | 69   | 41   |
| of which:  | Poultry *    | 82   | 85.2 | 48   | 67   |
|            | Sheep/goat   | 13   | 7.4  | 8    | 12   |
|            | Cattle       | 5    | 7.4  | 14   | 21   |

\* Poultry, sheep and cattle are percentage of the same in each Zone who reported losses.

The table reveals that about 12 to 18 percent farmers in different Zones experienced major damages to their houses. Only about 4 to 10 percent farmers across the Zones reported total damage to their houses. Damage to livestock affairs to be of high order particularly the loss of poultry.

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**APPENDIX E.II**  
**LANDLESS SURVEY**

## APPENDIX E.II

## LANDLESS SURVEY

The occupational picture of the landless people is summarised in the Table below:

TABLE E.II.1

## Occupational Analysis of Landless Survey

| Main Occupation      |     |       |     |       |     |       |     |       |
|----------------------|-----|-------|-----|-------|-----|-------|-----|-------|
|                      | A   |       | B   |       | C   |       | D   |       |
|                      | Nos | %     | Nos | %     | Nos | %     | Nos | %     |
| Labourer/casual work | 11  | 45.8  | 14  | 58.3  | 11  | 45.8  | 14  | 58.3  |
| Fishermen            | 2   | 8.3   | 0   | 0     | 0   | 0     | 2   | 8.3   |
| Skilled artisan      | -   | -     | -   | -     | -   | -     | -   | -     |
| Rickshaw Puller      | 5   | 20.8  | 6   | 25.0  | 5   | 20.8  | 4   | 16.7  |
| Shopkeeper/trade     | 4   | 16.7  | 3   | 12.5  | -   | -     | 1   | 4.2   |
| Clerk                | -   | -     | -   | -     | -   | -     | -   | -     |
| Other                | 2   | 8.3   | 1   | 4.2   | 8   | 33.3  | 3   | 12.5  |
| Total                | 24  | 100.0 | 24  | 100.0 | 24  | 100.0 | 24  | 100.0 |

| Second Occupation    |     |       |     |       |     |       |     |       |
|----------------------|-----|-------|-----|-------|-----|-------|-----|-------|
|                      | A   |       | B   |       | C   |       | D   |       |
|                      | Nos | %     | Nos | %     | Nos | %     | Nos | %     |
| Labour/casual worker | 4   | 16.7  | 3   | 12.5  | 1   | 4.2   | 4   | 16.7  |
| Fishermen            | 1   | 4.2   | 5   | 20.8  | -   | -     | -   | -     |
| Rickshaw Puller      | 1   | 4.2   | 1   | 4.2   | 1   | 4.2   | -   | -     |
| Shopkeeper/trade     | -   | -     | 1   | 4.2   | -   | -     | 1   | 4.2   |
| other                | 1   | 4.2   | 3   | 12.5  | 4   | 16.7  | 6   | 25.0  |
| No second occupation | 17  | 70.8  | 11  | 45.8  | 18  | 75.0  | 13  | 54.2  |
| Total                | 24  | 100.0 | 24  | 100.0 | 24  | 100.0 | 24  | 100.0 |

Casual work represents the most important main occupation, about 50 percent, of the respondents. Rickshaw pulling comes second with around 20 percent of the respondents. Shopkeeping/trading is also an important, except Zone Z, main occupation. Secondary occupations are also found be supplementary sources of income. Landless people undertake casual work, fishing, rickshaw pulling, shopkeeping etc. to supplement their main source of income.



Earnings of the landless people due to various occupations are presented in the following Table.

TABLE E.II.2

Average Income in Taka per day of Landless People

|                     | A/M | M/J | J/JL | JL/A | A/S | S/O | O/N | N/D | D/JA | JA/F | F/M | M/A | TOTAL |
|---------------------|-----|-----|------|------|-----|-----|-----|-----|------|------|-----|-----|-------|
| Zone : A            |     |     |      |      |     |     |     |     |      |      |     |     |       |
| Farm work           | 26  | 26  | 29   | 26   | 26  | 26  | 27  | 27  | 27   | 28   | 28  | 28  | 27    |
| Fishing             | 40  | 40  | 33   | 33   | 43  | 55  | 40  |     |      |      |     |     | 40    |
| Carpentry           | 70  | 70  | 70   | 70   | 70  | 70  | 70  | 70  | 70   | 70   | 70  | 70  | 70    |
| Rickshaw/van        | 48  | 47  | 37   | 37   | 41  | 53  | 55  | 62  | 60   | 62   | 60  | 58  | 52    |
| Shopkeeper          | 29  | 30  | 31   | 30   | 26  | 27  | 41  | 48  | 48   | 33   | 30  | 28  | 33    |
| Other               |     | 70  | 45   | 45   | 45  | 50  | 50  |     |      | 40   | 80  | 80  | 53    |
| Total               | 34  | 36  | 35   | 33   | 35  | 38  | 39  | 40  | 39   | 39   | 40  | 38  | 37    |
| Zone : B            |     |     |      |      |     |     |     |     |      |      |     |     |       |
| Farm work           | 42  | 41  | 41   | 42   | 39  | 39  | 40  | 43  | 44   | 42   | 40  | 39  | 41    |
| Fishing             |     | 25  | 38   | 44   | 45  | 60  | 60  | 70  | 60   |      |     |     | 45    |
| Rice mill           | 27  | 27  | 24   | 24   | 22  | 27  | 30  | 32  | 32   | 33   | 34  | 32  | 29    |
| Carpentry           | 50  | 50  |      | 50   |     | 50  | 50  |     |      |      | 50  | 50  | 50    |
| Large industry      | 35  | 35  | 35   | 35   | 35  | 35  | 35  | 35  | 35   | 35   | 35  | 35  | 35    |
| Rickshaw/van        | 42  | 38  | 37   | 39   | 42  | 38  | 43  | 41  | 43   | 46   | 45  | 42  | 41    |
| Shopkeeper          | 43  | 37  | 36   | 36   | 38  | 38  | 38  | 40  | 48   | 50   | 40  | 43  | 40    |
| Other               | 30  | 30  | 30   |      |     | 30  | 30  |     |      |      |     |     | 30    |
| Total               | 41  | 38  | 37   | 40   | 40  | 39  | 40  | 42  | 44   | 43   | 41  | 40  | 40    |
| Zone : C            |     |     |      |      |     |     |     |     |      |      |     |     |       |
| Farm work           | 39  | 38  | 37   | 38   | 37  | 35  | 38  | 41  | 41   | 40   | 37  | 39  | 38    |
| Construction labour | 200 | 150 | 100  | 100  | 100 | 100 | 100 | 150 | 150  | 150  | 200 | 200 | 142   |
| Large industry      | 45  | 45  | 45   | 45   | 45  | 45  | 45  | 45  | 45   | 48   | 48  | 48  | 46    |
| Rickshaw/van        | 65  | 64  | 49   | 49   | 67  | 55  | 54  | 66  | 66   | 63   | 62  | 66  | 60    |
| Other               | 37  | 38  | 36   | 32   | 34  | 36  | 36  | 36  | 38   | 38   | 40  | 40  | 37    |
| Total               | 50  | 47  | 42   | 42   | 45  | 43  | 43  | 48  | 49   | 48   | 49  | 51  | 46    |
| Zone : D            |     |     |      |      |     |     |     |     |      |      |     |     |       |
| Farm work           | 34  | 35  | 30   | 30   | 32  | 29  | 30  | 33  | 35   | 32   | 32  | 33  | 32    |
| Fishing             | 40  | 33  | 28   | 28   | 28  | 38  | 38  | 50  | 50   | 50   | 60  | 60  | 38    |
| Construction labour |     | 40  |      |      | 40  |     |     |     | 30   |      |     | 40  | 38    |
| Rice mill           |     |     | 24   | 24   |     |     |     | 24  |      |      |     |     | 24    |
| Weaving             | 15  | 15  | 15   | 15   | 15  | 15  | 15  | 15  | 15   | 15   | 15  | 15  | 15    |
| Carpentry           | 60  | 60  | 60   | 60   | 63  | 63  | 63  | 63  | 63   | 63   | 63  | 63  | 62    |
| Rickshaw/van        | 45  | 40  | 30   | 30   | 25  | 29  | 29  | 49  | 50   | 54   | 54  | 55  | 41    |
| Shopkeeper          |     |     |      |      | 25  |     |     |     |      |      |     |     | 25    |
| Other               | 25  | 30  | 20   | 21   | 27  | 29  | 26  | 19  | 29   | 29   | 29  | 34  | 28    |
| Total               | 36  | 35  | 30   | 29   | 31  | 30  | 31  | 35  | 37   | 37   | 37  | 38  | 34    |

Non-farm works like carpentry, trading, fishing etc. turn out more remunerative as expected than casual farm work. However, earning rate from casual farm work appears to be low compared with the rates reported by farmers survey and other secondary sources. Thus for the purpose of obtaining current wage rate for casual farm work the landless survey is unreliable. Other informations of the landless are summarised in the following Table.

TABLE E.II.3

## Summary Landless Survey Indicators

|  | Zone  |       |       |       |
|--|-------|-------|-------|-------|
|  | A     | B     | C     | D     |
| Family Size  | 6.0   | 5.0   | 7.5   | 6.2   |
| Men  | 1.6   | 1.5   | 1.8   | 1.8   |
| Women  | 1.6   | 1.6   | 1.8   | 2.0   |
| Children   | 2.7   | 2.8   | 3.9   | 2.4   |
| Labourers  | 6.1   | 5.6   | 7.2   | 5.8   |
| Fishermen  | 5.0   | -     | -     | 6.5   |
| Other  | 6.0   | 6.4   | 7.8   | 6.8   |
| % Kutcha type house                                  | 91.7  | 100.0 | 83.3  | 100.0 |
| % Kutcha type house labourer & fishermen             | 92.3  | 100.0 | 91.0  | 100.0 |
| % Labourer who own house                             | 100.0 | 100.0 | 100.0 | 100.0 |
| % of sample reporting declining work opportunities   | 50.0  | 41.7  | 45.8  | 37.5  |
| % sample who fish                                    | 50.0  | 54.2  | 70.8  | 91.7  |
| Average monthly catch per farm labouring family (kg) | 9.0   | 10.0  | 11.0  | 13.0  |

It is important to note that 100 percent of the respondents have their own houses. The importance of fishing can be gauged from the fact that about 50 percent of the respondents in A and B Zones through 70 percent in Zone C to 90 percent in Zone D reports this activity to supplement their diets which is evident from the fact that farm labourers consume nearly 80, 90 and 100 percents of their catch respectively in Zone A, C & D. Only in Zone B over 50 percent farm labourers sell part of their catch. Declining work opportunities are reported by about 38 percent respondent in Zone D to 50 percent in Zone A.

Losses due to 1988 flood to the landless households are reported in the Table below.

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TABLE E.II.4

## Flood Damage Reported by Landless Respondents (1988)

|                      |             | Zone |      |      |      |
|----------------------|-------------|------|------|------|------|
|                      |             | A    | B    | C    | D    |
| Damage to housing:   | no loss     | 16   | 25   | 8.3  | -    |
|                      | minor loss  | -    | 8.3  | -    | -    |
|                      | Severe loss | -    | 33.3 | 4.2  | 4.2  |
|                      | destroyed   | 84   | 33.3 | 87.5 | 95.8 |
| Damage to Livestock: | report loss | 72   | 75   | 45.8 | 70.8 |
| of which:            | Cattle      | -    | 11.1 | 9.0  | -    |
|                      | Sheep/goat  | 11.0 | 5.6  | -    | 5.9  |
|                      | Poultry     | 89.0 | 83.3 | 91.0 | 94.1 |

Flood damage to the houses of the landless people appears to be highly exaggerated when this is compared with those of farmer survey. Total damage to the houses of over 80 percent respondents in Zone A and C and about 95 percent in Zone D seems a remote possibility. Damage data to livestock on the other hand appears to be sensible and agreeable with those of farmer survey.





**APPENDIX E.III**  
**FISH POND SURVEY**

## APPENDIX E.III

## FISH POND SURVEY

Tables E.III.1 and E.III.2 present information regarding the number, size, origin, ownership and status of fish ponds.

TABLE E.II.1

## Pond Holding Size: Fish Culture Survey

|   | Unit | A    | B     | C     | D     |
|---|------|------|-------|-------|-------|
| No. of respondents                        | No   | 24   | 24    | 24    | 24    |
| Total Number of ponds                     | No   | 66   | 124   | 95    | 94    |
| Average No. of ponds                      | No   | 3    | 5     | 4     | 4     |
| Total area of ponds                       | Ha   | 7.06 | 13.04 | 10.75 | 16.43 |
| Average size of ponds                     | Ha   | 0.11 | 0.11  | 0.11  | 0.18  |
| Average size of holding                   | Ha   | 0.29 | 0.54  | 0.45  | 0.68  |
| Area of ponds with water all year round.  | Ha   | 3.62 | 12.47 | 10.23 | 11.97 |
| Average size of ponds                     | Ha   | 0.05 | 0.10  | 0.11  | 0.13  |
| Average size of holding                   | Ha   | 0.15 | 0.52  | 0.43  | 0.50  |
| Area of pond without water all year round | Ha   | 3.45 | 0.57  | 0.52  | 4.45  |
| Average size of ponds                     | Ha   | 0.5  | 0.005 | 0.005 | 0.05  |
| Average size of holding                   | Ha   | 0.15 | 0.02  | 0.02  | 0.19  |

TABLE E.III.2

## Origin, Ownership and Status of Fish Ponds

|                                     | A    |       | B     |       | C     |       | D     |       |
|-------------------------------------|------|-------|-------|-------|-------|-------|-------|-------|
|                                     | ha   | %     | ha    | %     | ha    | %     | ha    | %     |
| Origin:                             |      |       |       |       |       |       |       |       |
| Built as fish pond                  | 1.56 | 22.1  | 13.04 | 100.0 | 2.84  | 26.4  | 2.85  | 17.4  |
| Formerly a barrow pit               | -    | -     | -     | -     | .06   | .6    | .04   | 2.4   |
| Natural pond/lake/river             | -    | -     | -     | -     | -     | -     | -     | -     |
| Dont know                           | 5.50 | 77.9  | -     | -     | 7.85  | 73.0  | 13.18 | 80.2  |
| Total                               | 7.06 | 100.0 | 13.04 | 100.0 | 10.75 | 100.0 | 16.43 | 100.0 |
| Ownership & Tenure:                 |      |       |       |       |       |       |       |       |
| Sole owner & operator               | 1.95 | 27.5  | 3.58  | 27.5  | 1.34  | 12.4  | 1.68  | 10.2  |
| Sole owner-rent out ponds to others | -    | -     | -     | -     | -     | -     | .42   | 2.6   |
| Share/Joint Ownership               | 4.34 | 61.5  | 3.74  | 28.7  | 5.96  | 55.4  | 7.29  | 44.4  |
| Rent in Private pond for cash       | .77  | 10.9  | 4.81  | 36.9  | 1.60  | 14.9  | 7.04  | 42.8  |
| Rent in govt./Khas pond for cash    | -    | -     | -     | -     | 1.59  | 14.8  | -     | -     |
| Rent in for share of fish           | -    | -     | .91   | 7.0   | .27   | 2.5   | -     | -     |
| Total                               | 7.06 | 100.0 | 13.04 | 100.0 | 10.75 | 100.0 | 16.43 | 100.0 |
| Status:                             |      |       |       |       |       |       |       |       |
| Pond disused-no fish caught         | .36  | 5.2   | -     | -     | .39   | 3.6   | 1.21  | 8.8   |
| Pond not stocked; wild fish caught  | -    | -     | -     | -     | .12   | 1.1   | .13   | 1.0   |
| Pond stocked with fingerlings       | 6.70 | 94.8  | 11.62 | 100.0 | 10.18 | 95.2  | 12.53 | 90.3  |
| Total                               | 7.06 | 100.0 | 11.62 | 100.0 | 10.69 | 100.0 | 13.87 | 100.0 |

The average size of ponds are rather small being about 0.13 hectare. About 43 percent of the total pond area is purpose built and it is encouraging that over 80 percent of the total pond area is operational throughout the year because they donot run dry any time and 95 percent of all ponds are stocked with fingerlings.

Shortage of water in some years is reported by about 28 percents and nearly 18 percent fish pond operator use LLP to supplement pond water.



The dominant form of ownership is the multiple ownership. The solution to the problem of multiple ownership seems to have been sought in renting for cash which closely follows joint ownership.

Yield and output of various types of fish ponds are presented in table below. Fish ponds which are operated

**TABLE E.III.3**

**Total area (ha), yield (t/ha) and output (Tk/ha)**

| Water and Status              | Zone : A |       |        | Zone : B |       |        | Zone : C |       |        | Zone : D |       |        |
|-------------------------------|----------|-------|--------|----------|-------|--------|----------|-------|--------|----------|-------|--------|
|                               | Area     | Yield | Output | Area     | Yield | Output | Area     | Yield | Output | Area     | Yield | Output |
| Pond Stocked with fingerlings |          |       |        |          |       |        |          |       |        |          |       |        |
| 1) Water year round           | 3.45     | 1.68  | 76753  | 11.22    | .96   | 43882  | 10.11    | 2.06  | 104013 | 7.96     | 1.79  | 80055  |
| 2) Dry for part of the year   | 3.25     | 1.65  | 77330  | .40      | .18   | 7410.0 | .07      | .77   | 24700  | 4.16     | 1.57  | 57185  |
| Pond not stocked              |          |       |        |          |       |        |          |       |        |          |       |        |
| 1) Water year round           | -        | -     | -      | -        | -     | -      | .12      | 1.23  | 65867  | .13      | .84   | 27694  |
| 2) Dry for part of the year   | -        | -     | -      | -        | -     | -      | -        | -     | -      | -        | -     | -      |

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TABLE E.III.4

Average Cost in Tk/ha of Fingerlings

| Zone     | Contains Enough Water | Dry for Part of the year |
|----------|-----------------------|--------------------------|
|          | Tk/ha                 | Tk/ha                    |
| Zone : A | 13550.67              | 10332.89                 |
| Zone : B | 7316.14               | 17290.00                 |
| Zone : C | 10153.22              | -                        |
| Zone : D | 11770.27              | 24729.64                 |

as hatcheries are not included here because the fingerlings are sold by number instead of weight and therefore are not comparable. The most important fish grown are local varieties of carps followed by carps of exotic varieties. Other types of fish grown are insignificant except in Zone C.

Yield differences are substantial and so are, as one would expect, output differences. Major costs of operating fish ponds are labour, feed and stocking. Labour, mostly own and family labour, is mainly used for draining, cleaning, guarding and feeding purposes. Catching of fish is mostly contracted out. The average cost of hired labour is Tk. 46, varying from Tk. 33 in Zone A to Tk. 53 in Zone B. The costs of stocking fingerlings appears very low in Zone B and very high in Zone D.

About 15 percent of fish is consumed by the pond operators and the rest are sold through different channels: 60 percent in the local market, 22 percent to the dealers at the pond side and 3 percent to the fishermen who buy the right to catch and sell the fish.

Regarding extension service, about 31 percent respondents received no advice at all. About 27 and 30 percents of the respondents received advices from other pond operators and fisheries officers respectively. The rest i.e. about 12 percent received advice from a wide range of sources like agricultural officer, BRDB, NGO etc.

Fish farming is, by and large, a self-financing enterprise within the farming system. Nearly 87 percent of these farmers meet their operating expenses from the proceeds of fish sale and other sources of income. Not much finance is obtained from bank (only about 5 percent) and other sources. The same is true in the case of capital expenditure like construction of new ponds which, of course, is not a common activity. Fish farming comes to be an important source of income in the farming system: about 62 percent respondents' main source of income is farming, 14 percent respondents' main income is fish farming and 56 percent respondents' secondary income comes from fish farming.

Flood damage to fish was very significant 1988. Average loss of fish production is reported to be nearly 60 percent in Zone B and over 70 percents in other Zones. The later floods are milder and their effects on fish production have been very much lower.

TABLE E.III.5

Average loss of production Through Flooding of Ponds (%)

|      | A   | B   | C   | D   |
|------|-----|-----|-----|-----|
| 1988 | 76  | 59  | 71  | 74  |
| 1989 | -   | 5.6 | 3.8 | -   |
| 1990 | -   | 8.8 | 5.2 | 9.0 |
| 1991 | 4.3 | 2.8 | -   | 8.6 |
| 1992 | -   | -   | -   | -   |

The most serious problem in the way of culture fishery is reported to be fish diseases. Credit constraint comes to be the second important problem followed by the non-availability of good quality fish fry.



**APPENDIX E.IV**  
**FISHERMEN (CAPTURE) SURVEY**

## APPENDIX E.IV

### FISHERMEN(CAPTURE) SURVEY

#### E.IV.1 Fishermen (Capture Fishery) Survey

Fishing is the principal means of living for about 60 percents of the fishermen interviewed. Farming and agricultural labour are main sources of income for about 20 and 15 percents of the fishermen. The vast majority, about 82 percent, of the fishermen, depend on other sources of income for their livelihood. These other sources are mainly farming, daily labour and shopkeeping/trading.

The main season of catching fish, as one would expect, is the aman season when 60 percent of the annual catch is made. Across the Zones, fish catch in aman season varies from 39 percent in Zone C to 82 percent in Zone D. Rabi season accounts for a little over 50 percent of the remainder.

Nets are the most common equipment of catching fish and this is done more in groups and for the most part at night. Approximately 1.5 kg was the average fish catch per fishermen per day in 1992. With a fish price of about Tk. 35 per kilogram, average rate of gross income was about Tk. 52.0 per day. Fish catches fell in 1992 by about 26 percent from a little over 2 kg per day in 1991, ostensibly because of very low flood in 1992. The decline in fish catches is a general trend, suggested by the fact that about 82 percent of the fishermen are using smaller mesh than they did five years ago and about three-fourth fishing for more days and prolonged hours now-a-days. Most importantly, 72 percent reported dwindling fish catches over the last 5 years. This has happened all along the line but the most common places are khals/internal rivers and flood-plains. Fish diseases is reported as the most important factor followed respectively by lower floods and obstruction of fish migration for the worsening situation. Despite this, the fishermen identified non-accessibility to capital rather than fish catch, which is relegated to the second, as the main problem of capture fishery.

A small percentage of fishermen, about 4, considers marketing and law and order situation as the main problems. Suggested measures, in order of preference, to improve fishermen's income are:

- 1) improved credit facilities for purchasing boats and gear
- 2) increase area and depth of water
- 3) ban on the use of mist nets
- 4) maintain existing water levels for longer
- 5) improve law and order

TABLE E.IV.1

## Distribution of Fishermen by Sources of Income

| Other Sources of Income  | A   |       | B   |       | C   |       | D   |        | Total |       |
|--------------------------|-----|-------|-----|-------|-----|-------|-----|--------|-------|-------|
|                          | Nos | %     | Nos | %     | Nos | %     | Nos | %      | Nos   | %     |
| Yes                      | 17  | 85.0  | 16  | 61.5  | 15  | 88.2  | 21  | 100.00 | 69    | 82.1  |
| No                       | 3   | 15.0  | 10  | 38.5  | 2   | 11.8  | -   | -      | 15    | 17.9  |
| Total                    | 20  | 100.0 | 26  | 100.0 | 17  | 100.0 | 21  | 100.0  | 84    | 100.0 |
| Main Sources of Income   | Nos | %     | Nos | %     | Nos | %     | Nos | %      | Nos   | %     |
| Fishing (Capture)        | 9   | 53    | 16  | 100.0 | 7   | 46.7  | 10  | 47.6   | 42    | 60.9  |
| Farming                  | 5   | 29    |     |       | 6   | 40.0  | 3   | 14.3   | 14    | 20.3  |
| Operator of fish ponds   | -   |       |     |       |     |       |     |        |       |       |
| Agricultural labour      | 3   | 18    |     |       | 1   | 6.7   | 6   | 28.6   | 10    | 14.5  |
| Other daily labour       | -   |       |     |       |     |       | 2   | 9.5    | 2     | 2.9   |
| Rural Industry           |     |       |     |       |     |       |     |        |       |       |
| Rickshaw/other transport |     |       |     |       | 1   | 6.7   |     |        | 1     | 1.4   |
| Trader/shop              |     |       |     |       |     |       |     |        |       |       |
| Government Job           |     |       |     |       |     |       |     |        |       |       |
| Total                    | 17  | 100.0 | 16  | 100.0 | 15  | 100.0 | 21  | 100.0  | 69    | 100.0 |
| Second Sources of Income | Nos | %     | Nos | %     | Nos | %     | Nos | %      | Nos   | %     |
| Fishing (Capture)        | 8   | 47.1  | -   |       | 6   | 40.0  | 10  | 47.6   | 24    | 34.8  |
| Farming                  | 2   | 11.8  | 7   | 43.8  | 3   | 20.0  | 5   | 23.8   | 17    | 24.6  |
| Operator of fish ponds   |     |       | 1   | 6.3   |     |       | 2   | 9.5    | 3     | 4.4   |
| Agriculture labour       | 6   | 35.3  |     |       | 5   | 33.3  | 2   | 9.5    | 13    | 18.8  |
| Other daily labour       |     |       | 3   | 18.8  | 1   | 6.7   | 2   | 9.5    | 6     | 8.7   |
| Rickshaw/other transport |     |       |     |       |     |       |     |        |       |       |
| Trader/shop              |     |       | 5   | 31.3  |     |       |     |        | 5     | 7.2   |
| Other                    | 1   | 5.9   |     |       |     |       |     |        | 1     | 1.5   |
| No second source         |     |       |     |       |     |       |     |        |       |       |
| Total                    | 17  | 100.0 |     | 100.0 | 15  | 100.0 | 21  | 100.0  | 69    | 100.0 |



TABLE E.IV.2

Number of Days Spent Fishing Per year (Fishermen)

|                    | A   | B   | C   | D   |
|--------------------|-----|-----|-----|-----|
| Minimum            | 90  | 168 | 60  | 60  |
| Maximum            | 350 | 355 | 365 | 365 |
| Average            | 199 | 277 | 186 | 169 |
| Standard Deviation | 82  | 55  | 107 | 69  |

TABLE E.IV.3

Changes in Fish Catches Over Last 5 Years (Responses)

|                     | Big Decrease |    |    |    | Small Decrease |   |   |   | Any Increase |    |   |   |
|---------------------|--------------|----|----|----|----------------|---|---|---|--------------|----|---|---|
|                     | A            | B  | C  | D  | A              | B | C | D | A            | B  | C | D |
| Permanent Beel      | -            | 3  | -  | -  | -              | - | - | - | -            | -  | - | - |
| Seasonal Beel       | -            | 5  | 2  | -  | -              | - | - | - | -            | -  | - | - |
| Khal/Internal River | 4            | 18 | 13 | 17 | 4              | 1 | - | - | 4            | -  | - | 2 |
| Major River         | -            | 3  | -  | 2  | -              | 1 | - | - | 12           | -  | - | - |
| Flood Plain         | -            | 11 | 11 | 4  | -              | 1 | - | - | -            | -  | - | - |
| Fish Pond           | -            | 7  | -  | -  | 12             | 6 | 2 | 1 | -            | 12 | 2 | 3 |
| Other               | 1            |    | 2  | 4  | 1              |   | 2 | - | 5            | -  | 2 | - |

TABLE E.IV.4

Reasons Given for Decline in Fish Catches (% Respondents)

|                               | A   | B    | C    | D    |
|-------------------------------|-----|------|------|------|
| Over Fishing                  | 8.3 | 9.1  | 10   | -    |
| Decline in Amount of water    | 25  | 27.3 | 30   | 50   |
| Obstruction of Fish Migration | 8.3 | 10.9 | 23.3 | 3.6  |
| Pollution                     | 25  | 3.6  | 6.7  | 25.0 |
| Fish Diseases                 | 8.3 | 45.5 | 43.3 | 21.4 |
| Other                         | 25  | 3.6  | 16.7 |      |

**APPENDIX E.V**  
**SURVEY METHODOLOGY**

## APPENDIX E.V

### SURVEY METHODOLOGY

#### E.5.1 Selection of Sample

A two stage random sample was drawn. The first stage consists in selecting a random sample of mouzas, and the second selecting farmers within the selected mouzas.

Unless a "large sample" (more than 10% of the population) can be selected, the statistical validity of a sample depends on its absolute size and not its proportion to the size of the population under investigation. Therefore, the following formula is used to determine sample size:

$$N = K^2V^2/D^2$$

where:         $N$  = sample size  
                $K$  = required level of confidence  
                $V$  = inherent variability of the subject under investigation  
                $D$  = acceptable margin of error in results

If  $K = 1.28$  - 85% confidence that our estimates will be correct

$V = 0.5$  - maximum value and, without other evidence, accepted as a norm in agricultural surveys.

$D = 10\%$  - our estimates will be accurate  $\pm 10\%$

Then the sample size can be calculated as  $N = 41$

For a clustered sample (as used in this survey) the sample size was adjusted for the "cluster effect" - that is the members of the same cluster will tend to be more similar to each other than to members of other clusters. This depends on the size of the cluster ( $m$ ) and the intra-cluster correlation coefficient ( $s$ ): the relationship being  $z = 1 + s(m-1)$ . If we take a typical value for  $s = 0.2$  and  $m = 8$  (as in this survey) then  $z = 2.4$ . The total sample size worked out to be  $41 \times 2.4 = 98$ . Further details of sample size calculation can be found in the Methodology Report. FAP 12 (HTS 1991).

The table below calculates sample size for a range of cluster sizes. The smaller the cluster the lower the value of  $z$  and the smaller the sample required. However a large number of clusters means that there is more work drawing up a sample frame (ie list of households) for each cluster. The optimum sample size is that which minimises the total work in both drawing up sample frame and carrying out interviews.



### SAMPLE SIZE AND MANPOWER NEEDS

|                      |     |     |     |     |     |     |     |     |     |     |     |
|----------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Cluster size         | 12  | 11  | 10  | 9   | 8   | 7   | 6   | 5   | 4   | 3   | 2   |
| Basic N              | 41  | 41  | 41  | 41  | 41  | 41  | 41  | 41  | 41  | 41  | 41  |
| z                    | 3.2 | 3   | 2.8 | 2.6 | 2.4 | 2.2 | 2   | 1.8 | 1.6 | 1.4 | 1.2 |
| Adjusted N           | 131 | 123 | 115 | 106 | 98  | 90  | 82  | 74  | 66  | 57  | 49  |
| No clusters per zone | 11  | 11  | 12  | 12  | 12  | 13  | 14  | 15  | 17  | 19  | 25  |
| Rounded N#           | 132 | 121 | 120 | 108 | 96  | 91  | 84  | 75  | 68  | 57  | 50  |
| No zones             | 4   | 4   | 4   | 4   | 4   | 4   | 4   | 4   | 4   | 4   | 4   |
| Total clusters       | 44  | 44  | 48  | 48  | 48  | 52  | 56  | 60  | 68  | 76  | 100 |
| Total sample         | 528 | 484 | 480 | 432 | 384 | 364 | 336 | 300 | 272 | 228 | 200 |
| Days to list frame   | 88  | 88  | 96  | 96  | 96  | 104 | 112 | 120 | 136 | 152 | 200 |
| Days to interview    | 132 | 121 | 120 | 108 | 96  | 91  | 84  | 75  | 68  | 57  | 50  |
| Total survey days    | 220 | 209 | 216 | 204 | 192 | 195 | 196 | 195 | 204 | 209 | 250 |

# devisable by the number of clusters

The table assumes, based on previous experience, that it will take 2 man-days to draw up a sample frame and one enumerator can do 4 interviews per day.

In this case the optimal cluster size is 8 - that is 8 farmers will be interviewed in each Mouza. We therefore need a sample of 96 for each group about which we wish to make separate estimates. These groups may be defined in terms of farm size, tenancy, land type or other factors. What is not allowed for is accurate estimates within sub-groups - for instance with a total sample size of 384 (4x96), we may be able to get accurate estimates for 4 different land types, and also for 4 different farm size groups, but not for different farm sizes with a particular land type.

## E.5.2 Methodology for Sample Selection

### E.5.2.1 Selection of First Stage Sample

The farmer survey would cover 8 farmers in each of 48 mouzas giving a total of 384 farmers. Selection of a statistically valid sample of farmers, using methods devised by FAP 12, involves the follows steps:

- (a) The area was divided into 4 zones with different flooding and agro-ecological characteristics. In Noakhali these zones are:

Zone A - better drained land in the south west around Lakshmipur

Zone B - land in the Begumganj depression extending down to Maijdi

Zone C - land between Zones B and D with intermediate flood condition

Zone D - land in the north of the project area, generally deeply flooded

These zones were marked on a map with the exact boundary of zones aligned with mouza boundaries. All the mouzas in each zone are listed on a spreadsheet with their area and population.

- (b) A random sample of 12 mouzas per zone, plus 3 spares is selected with probability of selection proportional to the population of the mouza. This is done by creating a list of the cumulative population of each mouza. A list of about 20 random numbers is then generated running between 1 and the cumulative total population of all the mouzas in the zone. This can be done in Lotus with the formula  $T * @RAND$  where T is the cumulative total. Copy this formula for 20 cells and then use the /RangeValue command to fix the numbers generated. Mouzas are selected if a random number falls within the range of their part of the cumulative total. If a mouza is selected twice, ignore this and use an additional random number to select another mouza.

### E.5.2.2 Selection of Second Stage Sample

- (a) The Union Council HQ for each of the selected mouzas was visited by a survey supervisor to obtain from the Chairman or Secretary a tax list showing names of all the heads of households in that mouza. This list was copied, and the mouza visited. The list is then reviewed with a knowledgeable, local person to up-date it and identify occupations of those on the list. Care should be taken to include all landless people on the list. This is in itself a useful piece of information as it shows the relative importance of different occupations in the project area. The list itself may identify land ownership, however the survey requires a list of farm operators rather than landowners. Farm operators include people who rent or sharecrop land. From the list of farm operators, a random selection of sixteen is made (eight plus eight spares) using a list of pre-printed random numbers.

Landless people, fishermen and fish pond operators were also be identified on the list, and a sample of two landless people (plus 2 spares) and two fish pond operators (plus 2 spares) should be selected at random. The landless people include all people who are not farm operators - this may include people such as teachers and land owners who have rented their land out to tenants/sharecroppers, as well as labourers and destitute persons. Fishermen were interviewed where they were found.

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Fish pond operators can be either farmers or landless. So it is possible to select, by chance, the same man to interview as a farmer and as a fish pond operator.

If the mouza is very large (has a over 1000 households), or covers a large area (so a sample would be widely scattered), it may be possible to select a sub-division of the mouza, such as a village or "para", at random and make a farmers list from that village alone. (This was sometimes done).

Experience has indicated that some mouzas are not in fact located as shown in the small areas atlas. Some no longer exist or have been washed away by rivers. Other close to towns may have become almost entirely urban. Three spare mouzas were selected so the supervisor could make substitutions in the field.

- (b) The enumerator then visits the mouza and interviews the selected farmers. The selection of eight spare farmers enables the enumerator to make a second choice if the selected farmer is not available.

Much time and effort is avoided if the second stage sample selection procedure is omitted, and enumerators just turn up to the selected mouza and interview the first farmers they meet. However previous surveys have shown that enumerators are more likely to find, and talk to, the larger, richer and full time farmer, who will be selected by the villagers as their representative to talk to an outsider. The sample would therefore not be statistically valid and would not give an accurate picture of the project area as a whole.

The case studies were selected from the completed questionnaires so more detailed information could be obtained from example farmers with a range of resource levels and land types. This also acts as a useful check on the completion of the survey forms by the enumerators.





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