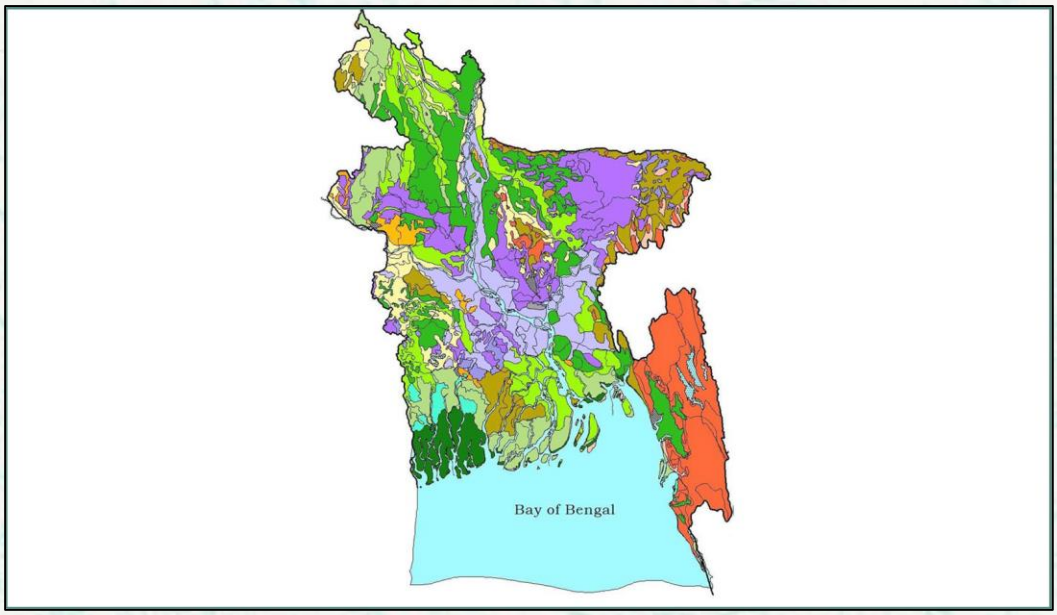
Harmonization of national land cover maps and land classification system



Bangladesh Forest Department

June 2016

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Food and Agriculture Organization of the United Nations

The Forest Department of Bangladesh leads actions to improve forest management and conservation, adopting forward thinking, innovative approaches in its management of approximately 1.55 million hectares of land across the country.

In 2015, the Forest Department began a process to establish a National Forest Inventory and Satellite Land Monitoring System for improved forest and natural resource management. The process supports national objectives related to climate change mitigation and provides information in support of the UN-REDD programme aimed at Reducing Emissions from Deforestation and Forest Degradation (REDD+). The process also addresses domestic information needs and supports national policy processes related to forests and the multitude of interconnected human and environmental systems that forests support.

The activities implemented under the Bangladesh Forest Inventory process are collaboration between several national and international institutions and stakeholders. National partners from multiple government departments and agencies assist in providing a nationally coordinated approach to land management. International partners, including the United Stated Agency for International Development (USAID) and the Food and Agriculture Organization of the United Nations (FAO) are supporting the development of technical and financial resources that will assist in institutionalizing the process.

The results will allow the Forest Department to provide regular, updated information about the status of trees and forests for a multitude of purposes including for assessment of role of trees for firewood, medicines, timber, and climate change mitigation.

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Introduction:

Land Cover is the physical/bio-physical cover of the earth surface. Land cover can be determined by analyzing satellite and aerial imagery. It includes vegetation and man-made features as well as bare rock, bare soil and inland water surfaces.

There are several organizations involved in land cover/use maps development at national and sub-national levels for Bangladesh. There is need for consistency in land cover maps to maximize their utilization among different stakeholders for achieving objectives/purposes of respective institutions and avoidance of conflicts, ensure cost and time effectiveness and easy interpretation of Land Use change and use them in national planning and management.

Soil Resource Development Institute (SRDI) is a government organization under the administrative control of Ministry of Agriculture. The aim of SRDI is to assist in achieving self-sufficiency in food and ensure food security for all through appropriate land & soil management for sustainable as well as environmentally friendly agriculture. It is entrusted to prepare inventory of soils of Bangladesh and generate information for sustainable crop production through improved soil management and preservation of environment. SRDI has prepared national level land use maps in 1996 and 2004.

Objectives: The main objective is to develop an improved national land cover/ use maps and knowledge regarding land use change.

Methodology for Land Use Mapping in Soil Resource Development Institute:

A. National Land Use Map 1996:

National Land Use Map 1996 (**Appendix-I**) is prepared mainly on the data and information (on land use) of RSS report along with few Upazilla wise "Land and Soil Resources Utilization Guide" popularly known as Upazilla Nirdeshika, followed by field verification. In every RSS report there is a map on Land Use Association along with soil unit wise land use information and in Upazilla Nirdeshika there is soil unit wise land use information. The following steps are followed during National Land Use Map preparation.

1. Preparation of district wise (21 Old districts) Land Use Map at 1: 250,000 scale through compilation of data-information of RSS and "Upazilla Land and Soil Resources Utilization Guide" and extrapolation of recent information collected during semi-detailed survey.

2. Preparation of Regional/Divisional Land Use Map through compilation "District Land Use Map" at 1: 500,000 scale.

3. Preparation of National Land Use Map through compilation "Regional/Divisional Land Use Map" at 1: 1000,000 scales.

4. Field verifications are made at every step.

5. District Land Use Map was prepared by SRDI District offices of SRDI. Cropping pattern which consist of 65 percent or more are considered as main land use and remaining land uses are not documented in the land use map.

6. Regional/Divisional Land Use Map was prepared by SRDI Regional offices (4 regional offices covering all 4 divisions of that time). Cropping pattern which consist of 65 percent or more are considered as main land use and remaining land uses are documented in the land use map.

7. National Land Use Map was prepared by SRDI Head Quarter in collaboration with regional heads and section heads at headquarter. Cropping pattern which consist of 65 percent or more are considered as main land use and remaining land uses are not documented in the national land use map.

8. Field verifications are made at district and regional and also at national level through pre-set and some randomly selected traverse line and locations.

B. National Land Use Map 2004:

National Land Use Map 2004 (**Appendix-II**) is prepared mainly on the data and information (on land use) of Upazilla wise "Land and Soil Resources Utilization Guide" popularly known as Upazilla Nirdeshika, followed by field verification. In every Upazilla Nirdeshika there is soil unit wise land use information. The following steps are followed during National Land Use Map preparation.

1. Preparation of Upazilla Land Use Map using data-information of "Upazilla Land and Soil Resources Utilization Guide" at 1: 100,000 scale.

2. Preparation of District Land Use Map through compilation "Upazilla Land Use Map" at 1: 250,000 scale.

3. Preparation of Regional/Divisional Land Use Map through compilation "District Land Use Map" at 1: 500,000 scale.

4. Preparation of National Land Use Map through compilation "Regional/Divisional Land Use Map" at 1: 1000,000 scales.

5. Field verifications are made at every step.

6. Upazilla and District Land Use Map were prepared by SRDI District offices following the methodology proposed by Land Use Planning Section of SRDI and approved by Departmental Technical Committee that is compilation of cropping patterns. Cropping pattern which consist at 50 percent or more are considered as main land use and remaining land uses are compiled as secondary land use.

7. Regional/Divisional Land Use Map was prepared by SRDI Regional offices (at present there are 6 regional offices covering all 9 divisions) following the methodology proposed by Land Use Planning Section of SRDI and approved by Departmental Technical Committee. Cropping pattern which consist of 50 percent or more are considered as main land use and remaining land uses are compiled as secondary land use.

8. National Land Use Map was prepared by SRDI Head Quarter following the methodology approved by Departmental Technical Committee under the leadership of Land Use Planning Section involving regional heads, other sections of head quarter, cartography and GIS. Cropping pattern which consist of 50 percent or more are considered as main land use and remaining land uses are compiled as secondary land use.

9. Field verifications are made at Upazilla, district and divisional/regional and also at national level through pre-set and some randomly selected traverse line and locations.

Some important features of Land Use Map:

1. Basically it is a crop rotation map prepared with objectives to provide database for planning sustainable agricultural development programme at local, regional and national level and also providing database in assessing requirement of agricultural inputs like, seed, fertilizer, pesticides and irrigations.

2. Main data on land use were collected during field survey following standard soil survey methodology through interviewing farmers. Thematic soil map was prepared through interpretation of aerial photograph, review of existing knowledge such as reconnaissance soil survey reports, topographic sheets, etc. A network of traverses is laid down so to examine the major landscapes units recognized by the study of aerial photographs. Soils were examined as often as necessary along the traverse lines. The traverse lines and sampling intensity varied from 200-250 hectares according to complexity soils. Where soil sampling is made, information on land use is recorded through interviewing farmers of the plot or location. Land use data also collected through surveyor observation during survey. All the land use information were tried to collect but land use pattern covering less than 5 percent of the soil unit (mapping unit) is not documented in final report.

3. Land use information in the Upazilla Nirdeshika is almost reality (considering standard error) at the time of survey.

4. SRDI requires 8-10 years to conduct one cycle of field survey for all the Upazillas.

5. Homesteads and townships except Dhaka are not shown in the land use map because of mapping scale. In national land use map 1 square centimetre is equivalent to 100 square kilometres in the ground.

C. Methodology of transferring SRDI Land Use Map Legend to LCCS Software

i) Description of data used: The data mainly used for the classification system is the Land use Map interpretation data of the Land use Map 2004 and 1996. In case of merging the same land use class (which were separated before by the secondary land use) and Expert opinion has been taken from the high officials of SRDI who were involved in preparation of national land use map.

ii) Description of software used: LCCS 3 Version: 3

iii) Description of tasks undertaken to translate the legend and harmonise the shape files:

- 26 Land Use classes have been prepared out of 49 Land Use Classes from the legend of Land Use map 2004.
- Land Use classes have been identified considering the main Land Use pattern.
- Similar Primary Land Uses have merged to a single Land Use Class.
- To insert the legend of Land Use map of SRDI 2004, secondary Land Uses have been compromised.
- First crop of each season of a pattern has been chosen as main crop of that season of the particular area. For example, in the case of the pattern Rabi crops/Fallow- Aus/Jute- T. aman, Rabi crops are the main crop of first season while Aus is considered as the main crop of the second season of the year.

Description of Mapping Units:

In Bangladesh there are 3 seasons in one year; i.e. Rabi, Kharif1 and Kharif2. Farmers usually grow three crops in 3(three) cropping seasons. Sometimes they grow two crops in three cropping season keeping one cropping season fallow and sometime they grow only one crop remaining the land fallow for 2 consecutive seasons. It depends on seasonal inundation, depth of inundation, availability of the irrigation water, unfavourable circumstance, farmer's choice, farmer's capability etc. If they manage to overcome the situation the land goes under cultivation again. Typically, farmers planted crops as close together as possible to utilise all the available land.

Land Use Map 1996

Classes for LCCS (Map code)	Cropping pattern	Description
1	Rabi crops-B.aus–Fallow	Rabi crops are those crops which are grown on Rabi seasons. Duration of Rabi seasons lies generally from mid November to end of the March. Rabi crops include- - Pulses (Lentil, Gram, Black Gram etc) - Oil seeds (Mustard, Soybean, etc) - Vegetables (Radish, Carrot, Cabbage, Cauliflower, spinach, Red amaranth, Bean etc.) - Others (Wheat, Maize etc.) B.aus is a broadcast rice grown in April and harvested at July. Fallow means the land remain uncultivated due to different reasons; e.g. Scarcity of irrigation water, unfavourable circumstance, Farmers choice,

Classes for LCCS (Map code)	Cropping pattern	Description
		Farmers capability etc. If they can manage to overcome the situation, to some extent the land goes under cultivation again.
2	Rabi crops-aus –T. aman	Rabi crops are those crops which are grown on Rabi seasons. Duration of Rabi seasons lies generally from mid November to end of the March. Rabi crops include- - Pulses (Lentil, Gram, Black Gram etc.) - Oil seeds (Mustard, Soybean, etc.) - Vegetables (Radish, Carrot, Cabbage, Cauliflower, spinach, Red amaranth, Bean etc.) Aus is that type of rice grown in April to July. T. aman is Transplanted aman paddy rice grown in July to October.
3	Fallow-aus –T. aman	Fallow means the land remain uncultivated due to different reasons; e.g. Scarcity of irrigation water, unfavourable circumstance, Farmers choice, Farmers capability etc. If they can manage to overcome the situation, to some extent the land goes under cultivation again. Aus is that type of rice grown in April to July. T. aman is Transplanted aman paddy rice grown in July to October.
4	Boro-Fallow-T. aman	Boro means Rabi season rice grown in December to April. Fallow means the land remain uncultivated due to different reasons; e.g. Scarcity of irrigation water, unfavourable circumstance, Farmers choice, Farmers capability etc. If they can manage to overcome the situation, to some extent the land goes under cultivation again. T. aman is Transplanted aman paddy rice grown in July to October.
5	Fallow-Fallow-T. aman	Fallow means the land remain uncultivated due to different reasons; e.g. Scarcity of irrigation water, unfavourable circumstance, Farmers choice,

Classes for LCCS (Map code)	Cropping pattern	Description
		Farmers capability etc. If they can manage to overcome the situation, to some extent the land goes under cultivation again. T. aman is Transplanted aman paddy rice grown in July to October.
6	Fallow-Shrimp-T. aman	Fallow means the land remain uncultivated due to different reasons; e.g. Scarcity of irrigation water, unfavourable circumstance, Farmers choice, Farmers capability etc. If they can manage to overcome the situation, to some extent the land goes under cultivation again. Shrimp is A kind of Aquaculture involves cultivating freshwater and saltwater shrimp under controlled conditions. T. aman is Transplanted aman paddy rice grown in July to October.
7	Rabi crops/Fallow-Mixed B.aus & aman	Rabi crops are those crops which are grown on Rabi seasons. Duration of Rabi seasons lies generally from mid November to end of the March. Rabi crops include- - Pulses(Lentil, Gram, Black Gram etc) - Oil seeds(Mustard, Soybean, etc) - Vegetables (Radish, Carrot, Cabbage, Cauliflower, spinach, Red amaranth, Bean etc) Mixed Broadcast Aus rice and Aman rice are cultivated through broadcasting both rice seeds at a time. Aus rice harvested after 3 month and Aman rice matured after 6 months i.e. duration of this crops season is March-October.
8	Fallow-B. aman	Fallow means the land remain uncultivated due to different reasons; e.g. Scarcity of irrigation water, unfavourable circumstance, Farmers choice, Farmers capability etc. If they can manage to overcome the situation, to some extent the land goes under cultivation again. B. aman means broadcast aman paddy
9	Boro-Fallow-Fallow	Boro means Rabi season rice grown in December to April.

Classes for LCCS (Map code)	Cropping pattern	Description
		Fallow means the land remain uncultivated due to different reasons; e.g. Scarcity of irrigation water, unfavourable circumstance, Farmers choice, Farmers capability etc. If they can manage to overcome the situation, to some extent the land goes under cultivation again.
10	Sugarcane	It is a perennial crop
11	Betel vine and vegetable	The betel (Piper betle) is the leaf of a vine belonging to the Piperaceae family. In Bangladesh, farmers prepare a garden called a barouj in which to grow betel. Proper shade and irrigation are essential for the successful cultivation of this crop. Betel needs constantly moist soil, but there should not be excessive moisture. Irrigation is frequent and light, and standing water should not remain for more than half an hour.
12	Orchard	This category includes orchards which are plantation of trees normally devoted to the production of fruit and nuts and any other types of plantations such as sugarcane.
13	Tea	Tea is a perennial shrub grown as a cash crop.
14	Upland Forest	This includes evergreen and deciduous forests in terrace and hilly areas(except mangrove forest)
15	Mangrove Forest	It is situated in the southern part of Satkhira, Khulna and Bagerhat districts, the south-western region of Bangladesh. It forms southern most of the Ganges and Brahamaputra river deltas and is shaped by the complex drainage structure. Topographic variation within this delta is very low. The forest floor lies between 0.9 m to 2.1 m above sea level. The whole area is dissected by large tidal river, with innumerable small channels and creeks. Sundri (Heritierafomes), gewa (Excoecariaagallocha), goran (Ceriopsdecandra) and other species.passur (Xylocarpusmekongensis) and dhandal (Xylocarpusgranatum). **Characteristics** Phenology: Evergreen

Classes for LCCS (Map code)	Cropping pattern	Description
		Leaf type: broad leaved Tree height: 5-20 m Crown cover:70-90%
16	Fallow (Water logged)	Land remains uncultivated due to submergence.
17	Beach	Beaches are the pebbly or sandy shore, especially by the ocean between high- and low-water marks. The area of accumulated sand, stone, or gravel deposited along a shore by the action of waves and tides also refer to Beaches, which usually slope gently toward the body of water they border and have a concave shape.
18	Mud Flat	Mudflat is a flat area of very wet soil near the sea that is covered at high tide. Mudflats refer to a tract of low muddy land, especially near an estuary that is covered at high tide and exposed at low tide.

Land Use Map 2004

Classes for LCCS (Map code)	Cropping pattern	Description
1	**Rabi Vegetable-Kharif Vegetable**	Vegetables that are grown in Rabi season, generally in the month of November to February. Some Rabi crops are: Radish, Carrot, Spinach, Red amaranth, Country bean, Cabbage, Cauliflower etc. Vegetables that are grown in Kharif1 and Kharif2 seasons generally in the month of March to October. Some Kharif vegetables are: White gourd, Bittle gourd, Pointed gourd, Snake gourd etc.
2	**RC-B.aus/Jute/Fallow**	Rabi crops (RC) are those crops which are grown on Rabi seasons. Duration of Rabi seasons lies generally from mid November to end of the March. Rabi crops include- - Pulses(Lentil, Gram, Black Gram etc) - Oil seeds(Mustard, Soybean, etc) - Vegetables (Radish, Carrot, Cabbage,

Classes for LCCS (Map code)	Cropping pattern	Description
		Cauliflower, spinach, Red amaranth, Country bean etc) B.aus means broadcast aman paddy grown in the month of April to July
3	**RC/fallow-Aus/Jute-T. aman**	Rabi crops (RC) are those crops which are grown on Rabi seasons. Duration of Rabi seasons lies generally from mid November to end of the March. Some Rabi crops are Pulses, Oil seeds, Vegetables etc. Aus is that type of rice grown in April to July. T. aman is Transplanted aman paddy rice grown in July to October.
4	**Fallow-T. aus-T. aman**	Fallow means the land remain uncultivated due to different reasons; e.g. Scarcity of irrigation water, unfavourable circumstance, Farmers choice, Farmers capability etc. If they can manage to overcome the situation, to some extent the land goes under cultivation again. T.aus is Transplanted aus paddy rice grown in August to November T. aman is Transplanted aman paddy rice grown in July to October.
5	**Rc/Fallow-Jute/fallow-T. aman**	Rabi crops (RC) are those crops which are grown on Rabi seasons. Duration of Rabi seasons lies generally from mid November to end of the March. Some Rabi crops are Pulses, Oil seeds, Vegetables etc. Jute is a long, soft, shiny vegetable fibre that can be spun into coarse, strong threads. It is produced primarily from plants in the genus Corchorus, which was once classified with the family Tiliaceae, more recently with Malvaceae. Growing time: Generally April to July. T. aman is Transplanted aman paddy rice grown in July to October.

Classes for LCCS (Map code)	Cropping pattern	Description
6	**Fallow-Fallow-T. aman**	Fallow means the land remain uncultivated due to different reasons; e.g. Scarcity of irrigation water, unfavourable circumstance, Farmers choice, Farmers capability etc. If they can manage to overcome the situation, to some extent the land goes under cultivation again. T. aman is Transplanted aman paddy rice grown in July to October.
7	**Potaro- Boro -T. aman**	Potato is a tuber crop grown in November to January Boro means Rabi season rice grown in December to April. T. aman is Transplanted aman paddy rice grown in July to October.
8	**Boro-T. aus-T. aman**	Boro means Rabi season rice grown in December to April. T.aus is Transplanted aus paddy rice grown in August to November T. aman is Transplanted aman paddy rice grown in July to October.
9	**Boro-T. aman**	Boro means Rabi season rice grown in December to April. T. aman is Transplanted aman paddy rice grown in July to October.
10	**RC -B.Aman**	Rabi crops (RC) are those crops which are grown on Rabi seasons. Duration of Rabi seasons lies generally from mid November to end of the March. Some Rabi crops are Pulses, Oil seeds, Vegetables etc. B. aman means broadcast aman paddy, grown the month of March to November.
11	**Boro -B. aman**	Boro means Rabi season rice grown in December to April. B. aman means broadcast aman paddy, grown the month of March to November.

Classes for LCCS (Map code)	Cropping pattern	Description
12	**Fallow -B. aman**	Fallow means the land remain uncultivated due to different reasons; e.g. Scarcity of irrigation water, unfavourable circumstance, Farmers choice, Farmers capability etc. If they manage to overcome the situation the land goes under cultivation again. B. aman means broadcast aman paddy, grown the month of March to November.
13	**Boro -Fallow**	Boro means Rabi season rice grown in December to April. Fallow means the land remain uncultivated due to different reasons; e.g. Scarcity of irrigation water, unfavourable circumstance, Farmers choice, Farmers capability etc. If they can manage to overcome the situation, to some extent the land goes under cultivation again.
14	**Pineapple**	It is a perennial crop
15	**Sugarcane**	It is a perennial crop
16	**Orchard**	This category includes orchards which are plantation of trees normally devoted to the production of fruit and nuts and any other types of plantations such as sugarcane.
17	**Tea**	Tea is a perennial shrub grown as a cash crop.
18	**Shrimp**	A kind of Aquaculture involves cultivating freshwater and saltwater shrimp under controlled conditions.
19	**Mixed Evergreen & Deciduous Forest**	Upland low hill forest. Situated mainly in greater Sylhet region (Moulvibazar, Sylhet, Habiganj district)
20	**Mixed Thickets & Forest**	Upland high hill forest. Situated mainly in Rangamaki, Bandarban, Khagrachhari district of Bangladesh.
21	**Sal**	Sal Forest a forest type dominated by a single plant species, commonly known as Sal tree (Shorearobusta). It belongs to the category 'Tropical Moist Deciduous Forest'. Sal forests

Classes for LCCS (Map code)	Cropping pattern	Description
		have a fairly wide but interrupted distribution in drier central and northern part of the mainland, mostly occurring in Gazipur, Tangail, Mymensingh, Jamalpur, Comilla, Dinajpur, Thakurgaon, Rangpur and Rajshahi districts. **Characteristics** Phenology: deciduous Leaf type: borad-leaved Tree height: 5-25m
22	**Mangrove**	It is situated in the southern part of Satkhira, Khulna and Bagerhat districts, the south-western region of Bangladesh. It forms southern most of the Ganges and Brahamaputra river deltas and is shaped by the complex drainage structure. Topographic variation within this delta is very low. The forest floor lies between 0.9 m to 2.1 m above sea level. The whole area is dissected by large tidal river, with innumerable small channels and creeks. Sundri (Heritierafomes), gewa (Excoecariaagallocha), goran (Ceriopsdecandra) and other species passur (Xylocarpusmekongensis) and dhandal (Xylocarpusgranatum). **Characteristics** Phenology: Evergreen Leaf type: broad leaved Tree height: 5-20 m Crown cover:70-90%
23	**Planted Mangrove Forest**	Mangrove plantation: These are plantations established in newly accreted lands of coastal Bangladesh.Bangladesh is pioneer in mangrove plantation. Districts where Mangrove plantations done are: Barguna, Patuakhali, Bhola, Noakhali, Chittagong, Cox's Bazar, Laxmipur. In older plantations other species like Rhizophora, exochorea, ceriops are coming up. **Characteristics** Phenology: Evergreen Leaf type: Broad-leaved Species planted: Keora *(Sonneratiaapetalla)*, Baen *(Avecinia alba)*. Gewa *(exochoreaagalocha)*

Classes for LCCS (Map code)	Cropping pattern	Description
24	**Beach**	Beaches are the pebbly or sandy shore, especially by the ocean between high- and low-water marks. The area of accumulated sand, stone, or gravel deposited along a shore by the action of waves and tides also refer to Beaches, which usually slope gently toward the body of water they border and have a concave shape.
25	**Fallow (Mud Land)**	Mudflat is a flat area of very wet soil near the sea that is covered at high tide. Mudflats refer to a tract of low muddy land, especially near an estuary that is covered at high tide and exposed at low tide.
26	**Salt bed**	Salt pans are flat expanses of ground covered with salt and other minerals.

Activities:

- Translation of the existing SRDI Land Use Map legends into LCCS
  - 18 Classes for Land Use Map 1996 (**Table-I)**
  - 26 Classes for Land Use Map 2004 (**Table-II)**

- Development of a national land cover legend
  - National legend produced and validated in LCCS3 software
  - A textual description of each class in the legend
  - LCCS diagram for each class
- Harmonization of existing land cover databases

  This activity involves harmonizing the Land Use for 1996 and 2004 in regards to:
  - Definition
  - Topology
  - Coordinate system
  - Projection
  - Other inconsistencies

Results/Discussion:

Outcome of the work: A translated legend of Land use map of SRDI at 2004 and 1996 have come out by which 26 classes of 2004 and 18 classes from 1996 have been sorted out for the LCCS and all are inserted to LCCS with important attributes **(Appendix-IIIa & IIIb)**.

Problems/Limitations of the process:

- As the land Use Map of SRDI is crop sequence or crop rotation based it was not directly adjusted with the LCCS3 software
- Fallow in a cropping pattern of SRDI Land use map means uncultivated land for some months of a cropping season which is not bare soil. So it is not logical for SRDI to put fallow in abiotic characteristics in LCCS. But in LCCS fallow means bare soil.
- Alternative crop within a single cropping pattern like RC-B.Aus/Jute-fallow cannot be accommodated in LCCS.
- Graminae cannot be selected after selection of Herbaceous

Conclusion and Recommendations:

This documentation could be helpful to develop a common reference system for land cover classification in Bangladesh. As SRDI Land use maps are crop rotation based, harmonization of map legends in LCCS may not yield a perfect Land Cover of Bangladesh. Some modifications of the LCCCs software tools may be needed to best fit of SRDI legends to get better results.

Table-I: Classes for Land Use Map 1996

Classes for LCCS (Map code)	Land use 1996	Existing Map code
1	Rabi crops-B.aus–Fallow	1
2	Rabi crops-aus –T. aman	2
3	Fallow-aus –T. aman	3
4	Boro-Fallow-T. aman	4
5	Fallow – Fallow – T. aman	5
6	Fallow – shrimp – T. aman	6
7	Rabi crops/Fallow-Mixed B.aus & aman	7
8	Fallow – B. aman	8
9	Boro-Fallow – Fallow	9
10	Sugarcane	10
11	Betel vine and vegetable	11
12	Orchard	12
13	Tea	13
14	Upland Forest	14
15	Mangrove Forest	15
16	Fallow (Water logged)	16
17	Beach	17
18	Mud Flat	18

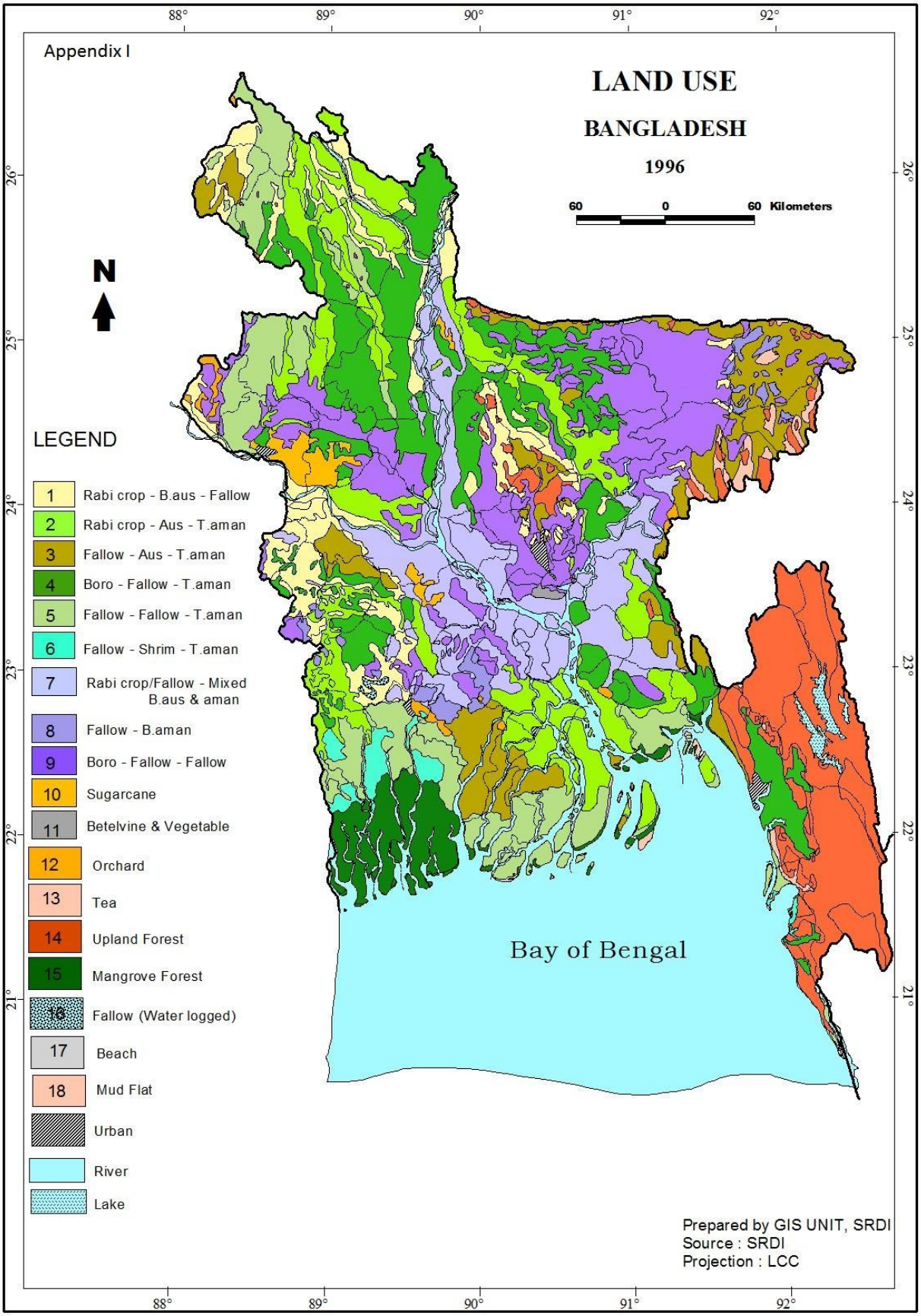
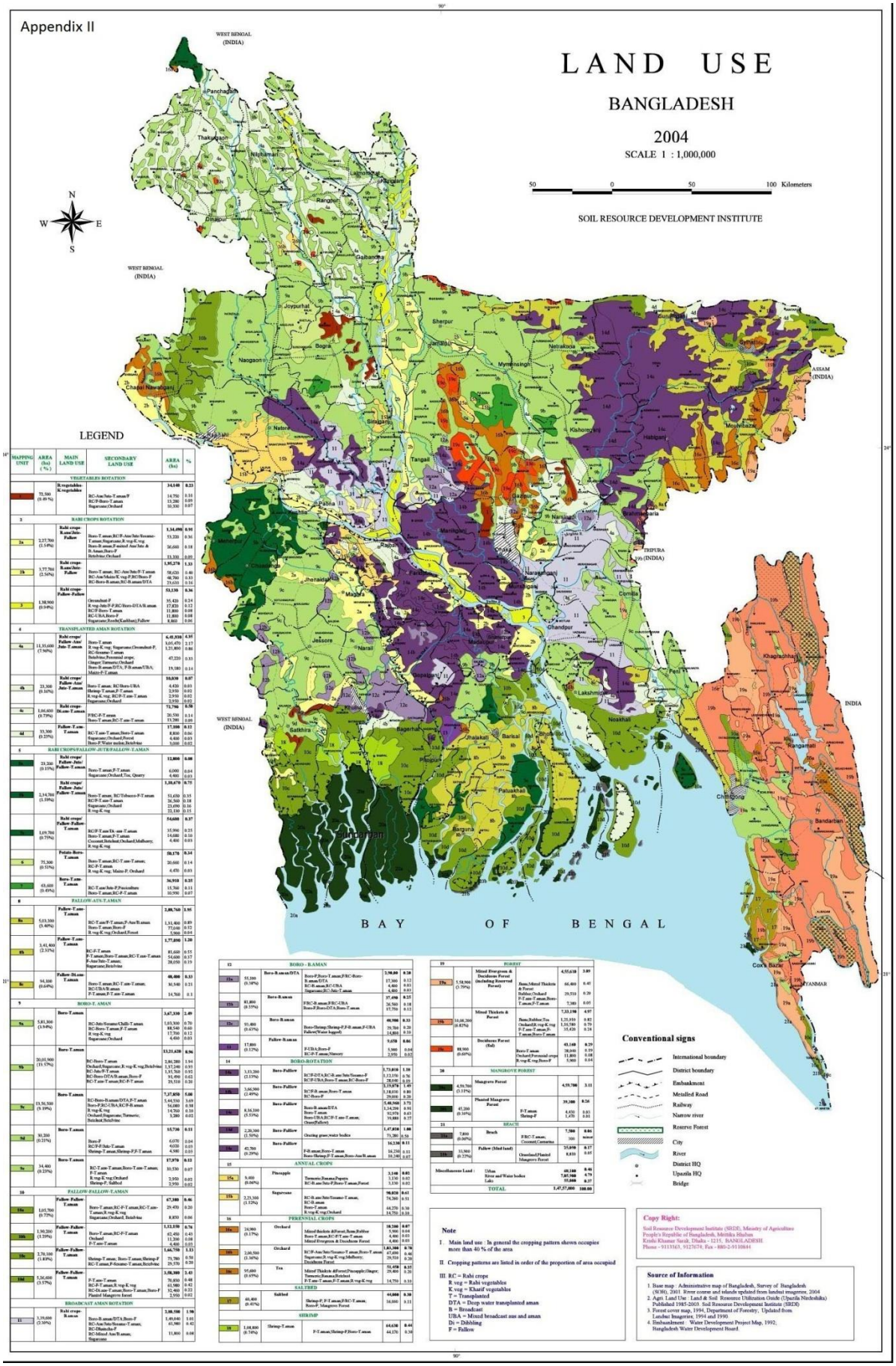
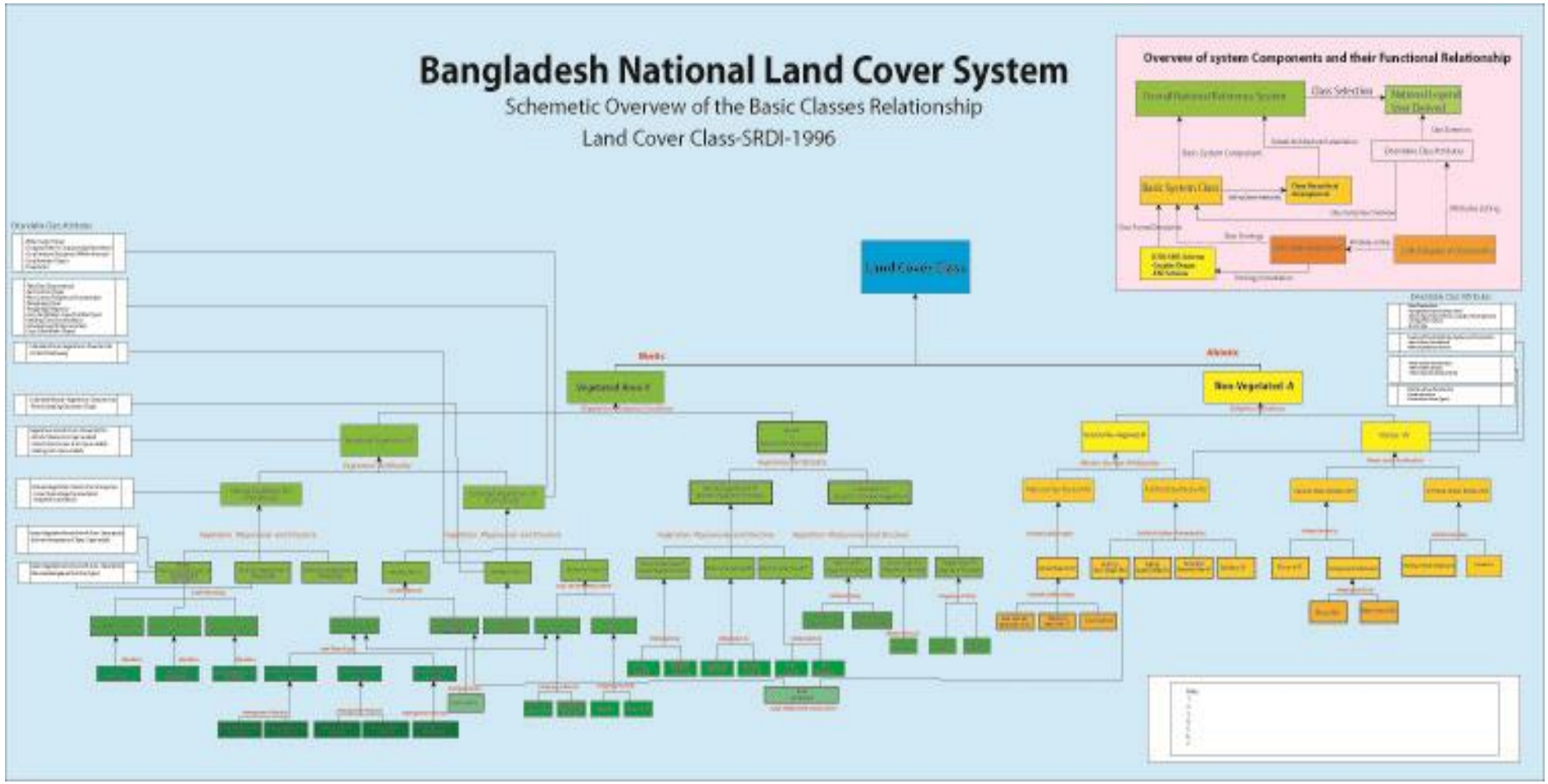

Appendix I
LAND USE
BANGLADESH
1996
60 0 60 Kilometers
N
LEGEND
1 Rabi crop - B.aus - Fallow
2 Rabi crop - Aus - T.aman
3 Fallow - Aus - T.aman
4 Boro - Fallow - T.aman
5 Fallow - Fallow - T.aman
6 Fallow - Shrim - T.aman
7 Rabi crop/Fallow - Mixed B.aus & aman
8 Fallow - B.aman
9 Boro - Fallow - Fallow
10 Sugarcane
11 Betelvine & Vegetable
12 Orchard
13 Tea
14 Upland Forest
15 Mangrove Forest
16 Fallow (Water logged)
17 Beach
18 Mud Flat
Urban
River
Lake
Bay of Bengal
Prepared by GIS UNIT, SRDI
Source : SRDI
Projection : LCC
88° 89° 90° 91° 92°
26° 25° 24° 23° 22° 21°

Table-II: Classes for Land Use Map 2004

Classes for LCCS (Map code)	Land use 2004	Existing Map code	Remarks
1	Rabi Vegetable- Kharif Vegetable	1	
2	RC-B.aus/Jute/Fallow	2a, 2b, 3	Map codes are merged based on Rabi Crop Rotation
3	RC/fallow-Aus/Jute-T. aman	4a, 4b, 4c	Map codes are merged based on similar main land use pattern
4	Fallow-T.aus-T. aman	4d, 8a, 8b, 8c	Ditto
5	Rc/Fallow-Jute/fallow-T. aman	5a, 5b, 5c	Ditto
6	Fallow-Fallow-T. aman	10a, 10b, 10c, 10d	Ditto
7	Potaro- Boro -T. aman	6	
8	Boro-T.aus-T. aman	7	
9	Boro-T. aman	9a, 9b, 9c, 9d, 9e	Map codes are merged based on similar main land use pattern
10	RC -B. aman	11	
11	Boro -B. aman	12a, 12b, 12c	Map codes are merged based on similar main land use pattern
12	Fallow -B. aman	13	
13	Boro -Fallow	14a, 14b, 14c, 14d, 14e	Map codes are merged based on similar main land use pattern
14	Pineapple	15a	
15	Sugarcane	15b	
16	Orchard	16a, 16b	Map codes are merged based on similar main land use pattern
17	Tea	16c	
18	Shrimp	18	
19	Mixed Evergreen & Deciduous Forest	19a	
20	Mixed Thickets & Forest	19b	
21	Sal	19c	
22	Mangrove	20a	
23	Planted Mangrove Forest	20b	
24	Beach	21a	
25	Fallow(Mud Land)	21b	
26	Saltbed	17	


Appendix II
LAND USE
BANGLADESH
2004
SCALE 1 : 1,000,000
50 0 50 100 Kilometers
SOIL RESOURCE DEVELOPMENT INSTITUTE
WEST BENGAL (INDIA)
ASSAM (INDIA)
TRIPURA (INDIA)
INDIA
MYANMAR
BAY OF BENGAL
LEGEND
Conventional signs
International boundary
District boundary
Embankment
Metalled Road
Railway
Narrow river
Reserve Forest
City
River
District HQ
Upazila HQ
Bridge
Note
I. Main land use : In general the cropping pattern shown occupies more than 40 % of the area
II. Cropping patterns are listed in order of the proportion of area occupied
III. R.C = Rabi crops
R veg = Rabi vegetables
K veg = Kharif vegetables
T = Transplanted
DTA = Deep water transplanted aman
B = Broadcast
UBA = Mixed broadcast aus and aman
Di = Dibbling
F = Fallow
Copy Right:
Soil Resource Development Institute (SRDI), Ministry of Agriculture
People's Republic of Bangladesh, Mrittika Bhaban
Krishi Khamar Sarak, Dhaka - 1215, BANGLADESH.
Phone - 9133163, 9127674; Fax - 880-2-9110844
Source of Information
1. Base map : Administrative map of Bangladesh, Survey of Bangladesh (SOB), 2001. River course and islands updated from landsat imageries, 2004
2. Agri. Land Use : Land & Soil Resource Utilization Guide (Upazila Nirdeshika) Published 1985-2003. Soil Resource Development Institute (SRDI)
3. Forest cover map, 1994, Department of Forestry, Updated from: Landsat Imageries, 1994 and 1990
4. Embankment : Water Development Project Map, 1992; Bangladesh Water Development Board.

Appendix-IIIa



Appendix-IIIb