Proceedings of
the National Consultation Conference on
Land Cover/Use Classification in
Bangladesh

Bangladesh Forest Department
16 March 2016

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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Executive Summary

Bangladesh faces several issues related to inconsistency of land representation between (sub-) national legends and over time such as (1) incomplete datasets may mean that some land cover/use may not be represented, (2) If different national datasets exist they may vary, e.g., in their estimates of forest land area, and thus limit the integration of sub-national data and activities, and (3) inappropriate description and documentation of the national classification system limits its use by different entities and individuals over time and the overall sustainability of the system.

Information about land cover and natural resource monitoring serves multiple purposes, such as commercial uses, national security, environmental protection, natural resource management, climate change mitigation and tracking of greenhouse gas emissions.

During the last decades several national and international entities were involved in land cover/land use mapping, at different levels, by making use of remote sensing and ancillary data (Akhter & Shaheduzzaman, 2013). Akhter and Shaheduzzaman (2013) have made an inventory of national and sub-national land cover products in Bangladesh. But due to differences in organizational purposes, methodologies, boundaries, definitions, classification systems, varying means and capacities, the different land cover maps are different and not comparable in time and space.

Several problems in terms of transparency, accuracy, consistency, completeness and comparability of land cover assessments limit the potential use of those existing maps. Many of the description of legends used for land cover mapping are not available and the classes are not appropriately described. Accuracy assessment is not performed in most cases. In some cases, the classification system for a single thematic area is not the same for different projects in an organization itself.

In brief, organizational differences are highly manifested not only in the end products but also in the processes involved. Hence, the use of the different land cover/use maps and their integration into one system is limited by constraints such as lack of documentation, inconsistency in spatial and temporal resolutions, accessibility, different classification systems, etc.

With advancements in geospatial technology, the assessment and classification of land cover/use has become a key management tool across a range of disciples allowing information of the state of flux of the earth's surface observed from time to time. In addition, issues related to the semantic interoperability between the different land cover/use activities can be solved. Solving the problem related to the semantic interoperability allows the development of land cover/use maps that can be used for a multitude of purposes. While developing one national system for land cover/use mapping improve the cost-efficiency, it also contributes to improve the consistency between the various classification systems, increase management efficiency as

standardized information can be used for multiple purposes. However, defining a unified classification system that both allow interoperability across discipline and space responding to the needs of the varying agencies is difficult due to their inherently differing priorities.

In response, the Global Land Cover Network (GLCN), a joint initiative between FAO, UNEP and IAO, have developed the Land Cover Classification System (LCCS) tool to assist countries to both harmonizes existing land cover data and to establish a system where land cover classes are based on actual physical features present on the ground. In this way, the system favors an object oriented approach over one reliant on broad terminology that provides limited indication of the physical features it represents, and in doing so, the system presents a classification system that is transparent, comparable, standardized and replicable.

The latest version of LCCS (LCCS.v3) facilitates the understanding of the classes of land cover regardless of the scale of mapping, the type of coverage, method of data collection, or geographic location. LCCS3 is an implementation of LCML (Land Cover Meta Language), which became ISO standard in 2012 (19144-2:2012). The LCML provides a common reference structure for the comparison and integration of data for any generic land cover classification system, and describes different land cover classification systems based on the physiognomic aspects. Figure 1 represents the use of object based description system for the national reference system for land cover/use mapping activities for different purposes.

Total 42 participants (35 male and 07 female) attended in the conference.

Table of Contents

Acronyms

AFOLU	Agriculture forestry and other land uses
FAO	Food and Agriculture Organization of the United Nations
FD	Forest Department
FIGNSP	Forest Information Generation & Networking System Project
GHG	Greenhouse gases
LULUCF	Land use, land-use change and forestry
MRV	Measuring, Reporting and Verification
REDD+	Reducing emissions from deforestation and the role of conservation, Sustainable Management of forests and enhancement of forest carbon stocks in developing Countries.
RIMS	Resources Information Management System
SRDI	Soil Resource Development Institute
UMD	University of Maryland
UNFCCC	United Nations Framework Convention on Climate Change
BSGI	Bangladesh Society of Geo-informatics
BUET	Bangladesh University of Engineering and Technology

1. **Introduction**

Bangladesh faces several issues related to inconsistency of land representation between (sub-) national legends and over time such as (1) incomplete datasets may mean that some land cover/use may not be represented, (2) If different national datasets exist they may vary, e.g., in their estimates of forest land area, and thus limit the integration of sub-national data and activities, and (3) inappropriate description and documentation of the national classification system limits its use by different entities and individuals over time and the overall sustainability of the system.

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2. Inauguration Session

"Bangladesh is a land based economy"- said Mr. Mohammad Abdul Wazed, the Director General of Bangladesh Bureau of Statistics. Land is a major concern for the BBS and so it uses the information related to the land representation and population with geocode. The maps they produce have been used several times by the planners for measuring the distribution of national resources. But with the map that will be produced after the NFI project there will be a better scope of monitoring and assessing the forest and other land uses. The purpose of this national consultation conference is highly appropriate.

The Chief Conservator Officer of Bangladesh Forest Department Mr. Md. Yunus Ali appreciated the step of creating land cover/ use maps that has been taken by the FAO in collaboration with the Forest Department and many other governmental organizations. This national consultation is very important not only for the forest department but for the country in general. The Forest Department had the administrative maps before but is now developing land cover maps to determine the different types of vegetation element occur in Bangladesh. Precisely this means that the need to identify and monitor the land cover (covered by trees, shrubs, herbs etc.) has become mandatory and now a harmonized map is even more essential for a developing country like ours.

3. Overview of the Presentations

3.1. Presentation: Existing National and Sub-national Land Cover and Forest Maps: Limits and Gaps
Presented by: Zaheer Iqbal (Deputy Conservator of Forests-BFD)

This project focuses on creating a recent land cover/ use map for Bangladesh as there has been none since 2005 which was made by the Forest Department. The organizations that have been involved in forest mapping so far are Forest Department, SRDI (1996, 2004). The data they have used back then were mostly based on aerial photography and Landsat images.

As Bangladesh is very diverse when it comes to the forest types, it became much necessary for this country to build a map that can monitor this valuable natural resource of hers. The dominated types include- the mangrove forest of Sundarbans, Sal forests in the northern part and the Hill forests in the south-eastern part of our country. There are also some protected areas which are ecologically in critical condition.

The major gaps that have been found in the existing forest maps are:
- Inconsistency
- Incomplete national database
- No accuracy assessment

Trainings and workshops have been arranged to build the capacity and develop a team fully for the Classification, Calibration, validation, model development of the national forest classification system.

3.2. Presentation: Proposed Options for Improved Forest and Land Cover/ Use Map Development
Presented by: Dr. Mohammed Abed Hossain (BUET)

The present land cover/ use maps lack the consistency, completeness and transparency which leads to the semantic inoperability, considered as the most seen problem in the existing land cover/use mapping and to reduce that a common language should be used that will not only integrate the data but also will translate different definitions. LCML is a specific object oriented meta-language that not only integrates the several data bases but also allows comparison among them. This will further improve the data quality and efficiency in the use of information.

LCCS v3 is a software that is developed to function in a way where there is an overall implication of the LCML. It has therefore the access to make it function in an easy, fast and intuitive way that the application of the LCML, rules for the description of a given land feature. The process includes the following steps:

- ➢ LCCS manual
- ➢ Knowledge based experience
- ➢ Research
- ➢ National reference system, Refinement and description based on field measurements
- ➢ The structural approach of the LCCS and the description of how it is showed in the software
- ➢ Legend development for the land Cover/ use map
- ➢ Land Cover map development.

Overall LCCS v3 proposes a pragmatic methodology and emphasizes on standardizing the attribute terminology rather than the final categories. It avoids the traditional approach and focuses on defining objects with standard diagnostic attributes called classifiers. Those objects can be linked with an endless series of attributes to define the thematic meaning of any specific feature.

3.3. Presentation: Field Data Collection Manual on Land Cover/ use Classification System
Presented By: Mohammad Abdul Hadi and Mohammad Fazle Reza Sumon (BSGI)

The protocol for land features description has been developed on specific strategies and methodologies in support of the land cover classification system (LCCS v3). The objectives of the field survey were to cover the whole country that has been divided into six zones each containing almost 150 points. The maps from NFA 2005 and SRDA 2004 have been used to select the locations and collect information. The survey was sectioned into four categories:

Section 1 involves the finding of location of the plot, section 2 emphasizes on taking the photographs, section 3 focuses on measuring the canopy cover while section 4 is to collect data on the basis of LCCS attributes.

Many groups have been formed containing two members each and were given devices to support the data collection. They have been trained before going to the field and been provided the field data collection form, a GPS to mark the locations and a smart TAB that includes the android based application developed by FAO that will have the detail additional information about the vegetation element. The additional characteristics involve the phenology, leaf type, heights of the features etc.

A device named densitometer was provided to measure the canopy cover where the plot size plays a vital part as the method to determine the layers is based on the plot size. On one hand the canopy layer is denominated with 1 on the other the sky is titled with 0.

Following these procedures the BSGI has successfully collected information from 832 points in Maheshkhali, Chittagong, Bangladesh. The next step involves the input of these data with the help of LCCS v3 software.

3.4. Presentation: The Importance on Developing a National Reference System
Presented by: Mohammad Abdul Hadi (BSGI), Dr. Mohammed Abed Hossain (BUET)

There is no national system presenting the legends that can be used for a common reference for the maps. For remaining the consistency among the classification this is the most important thing to consider. The legend developed by the organizations that are working on the development national land cover classification system shows the details which will make it easier and smoother for the user to put a specific feature based onto its physiognomy. It encompasses on the structural framework of the forest hierarchy. It generated mostly on the genetic characteristics, involves some extendable class attributes, dominated areas of a vegetation type (tree, shrub, herbs etc.). This structure is a complete approach which proposes to include all forms of vegetation element/ features.

4. <u>Group Discussions</u>

4.1. <u>(Morning session)</u>

The participants were divided into four groups each containing a member from the BSGI to help them understand the procedures they developed and used to conduct the field survey. This session was mainly included to receive suggestions from other involvements that they may have and to improve the methodology. They have been provided a form of six questions based on the possible field of queries. One member from each of the groups represented the questions with elaborate explanations.

Group 1:

- To emphasize on the qualification background of the graduate students, while considering the selection of a field crew who will be responsible for the collection of data on a primary basis.
- To suggest on taking interviews and conducting periodic surveys in addition with the use of secondary data in multiple cropping land areas.
- Photographs along with every possible detail of an unknown feature should be collected and they agreed on using the GPS for higher accuracy.
- The manual should include user friendly terminologies to avoid any confusion.
- The manual can assist in Forest Inventory Data Collection.

Group 2:

- To select students who must have their academic background in science and a diploma in forestry.
- To consider the landowners vitally important in participating and contributing to the information on cultivating more than one crop in a land in one year.
- Resolution should be kept in mind while considering the devices that need to be used for data collection. The Tab of 10 inches, 2 GB RAM, 64 GB storage should be provided to the crew.
- To include all the data for different seasons, signs of tree removal, wildlife, biodiversity, deadwood and litter.
- To lessen the lack of canopy cover assessment and urge to cover that as much as possible.

Group 3:

- All the members of the field crew must have a graduation degree from forestry, agriculture or any other natural science with intensive field preparation training.
- Addition of cropping pattern information in the questionnaire and adapt approaches for multiple methods for the sake of collecting the most accurate data.

- There is no alternate to the field observation and primary, secondary data should be used to create a new class for the identification of the unknown class.
- The manual can be the guide towards assisting the forest inventory in data collection.
- In order to finalize the manual there is a necessity in verification of the field.

Group 4:

- The field crew must have a vision and an aptitude to conduct the survey. Should hold a minimum diploma in forestry for graduate students and higher secondary school certificate for undergraduate students and they must be have a good knowledge about the modern technology, must be quick learners.
- Agriculture: To capture temporal variations, a repeated approach and/or FGD for local knowledge for the history of the land and for agroforestry: information on all strata/canopy with biophysical attributes must be stored in order to collect the data for a multiple cropping land.
- Random with purposive sample method can be used for the unknown classes identified in the field.
- Along with the "open foris" application Nexus TAB can be used with the advantage of using Wi-Fi in it for the data collection. And the detail functions of the application should be explained in the manual in Bengali.
- The manual can partially assist the project but some Forest Inventory Field Forms should be ready to capture other features.
- The ecologists and agronomists can contribute to the advancement of this NFI project.

4.2. (Afternoon session)

This session opened the floor for the participants to ask or suggest anything about the national reference system that has not been included or has been missed out/ ignored.

- What are the national processes/projects related to the national and sub-national land cover mapping in Bangladesh (national and sub-national): The national land zoning projects by the NSDI, SPARSO.
- The necessity of having one national reference system: The proposed system along with the NSDI projects and should also hire the SOB (Survey of Bangladesh) in order to include a national organization in this process. According to Mr. Hadi the JAICA is facilitating the NSDI to make it happen as fast as possible.
- If yes, what is your preference? A fixed traditional system or a dynamic expandable one: What option can be chosen should push to its utmost limit and workshops should be arranged to discuss on it further.
- Which are the constraints for the adoption of the proposed national reference system: The lack of awareness among the people.

- What do you think about the general structure of the proposed national classification system:
- Based on the pictures provided and Google Earth, do you identify some land features that cannot be located in the proposed national reference system: Participants are welcomed to e-mail the snapshots they can find which they might find absent in the proposed national reference system and that can be tried to fit in the structure.

Conclusion:

Due to the dynamic changes in the land use pattern of Bangladesh, land cover/ use information has become extensively important for the country. With recent technological and scientific advances, new methods and approaches can be used to upgrade land cover/use mapping. The latest version of the FAO Land Cover Classification System (LCCS) aims to facilitate the understanding of the classes of land cover regardless of the scale of mapping, the type of coverage, method of data collection or geographic location. This National Consultation Conference promoted the idea of the necessity of a national reference system and to receive suggestions from respected government organizations in order to develop the system more efficaciously.

APPENDIX 1

National Consultation on Land Cover Classification System

Location: Bangladesh Bureau of Statistics, Agargaon, Dhaka, 16 March, 2016

Date	Topic	Speaker/facilitator
Morning	**Session 1:** Opening session	
9.00-9.30	Registration	Shuhala Ahasan
9.30-9.35	Welcome Address	Md. Mozaharul Islam Conservator of Forests Forest Department
9.35-9.45	Existing national and sub-national land cover and forest maps: limits and gaps	Mr. Zaheer Iqbal (BFD)
9.45-9-55	Proposed options for integrated forest and land cover monitoring and assessment: towards semantic interoperability	Dr. Mohammed Abed Hossain (BUET)
9.55-10.00	Special guest	Dr. Antonio D Gregorio (FAO)
10.00-10.05	Chief Guest	Mr. Mohammad Abdul Wazed Director General Bangladesh Bureau of Statistics
10.05-10.10	Address by the chair	Mr. Md. Yunus Ali Chief Conservator of Forests
10.10-10.30	Tea Break	
Morning	**Session2: Field data collection**	
10:30 AM	Presentation of the field data collection manual	Mr. Abdul Hadi (BSGI), Fazle Reza Sumon (BSGI)
	Group discussion about the field data collection manual	Dr. Mariam Akhter (FAO)
	Lunch Break	
Afternoon	**Session3: Draft Land Cover/Use National Classification System**	
2.00 PM	Presentation of the proposed national classification system for Bangladesh	Mr. Abdul Hadi (BSGI)
	Group discussion about the proposed national classification system	Laskar Muqsudur Rahman (FAO)
	Session 4: conclusion and ways to move forward	
	Next steps	Dr. Matieu Henry (FAO)
4:00 PM	Closing session	Laskar Muqsudur Rahman

APPENDIX 2

List of the Participants:

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