Proceedings of the regional exchange workshop on forest monitoring and assessment

Bangladesh Forest Department
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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), the Food and Agriculture Organization of the United Nations (FAO) and US Forest Service through its management of the SilvaCarbon Bangladesh program 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, climate change mitigation.

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ACRONYMS

AGB-Above Ground Biomass

BGB-Below Ground Biomass

NFI-National Forest Inventory

BFD-Bangladesh Forest Department

FAO-The Food and Agriculture Organization of United Nations

USFS-United States Forest Service

FREL-Forest reference emission levels

REDD+- Reducing Emissions from Deforestation and Forest Degradation

RFID-Radio-frequency identification chip

LiDAR- Light Detection and Ranging

BMP- Best Management Practice

USDA-United States Department of Agriculture

USAID-United States Agency for International Development

GEDI-Global Ecosystem Dynamics Investigation

LCML-Land Cover Meta Language

LCCS- Land Cover classification system.

QA-Quality Assessment

QC-Quality Control

DBH-Diameter, Breast and Height

GHG-Greenhouse Gases

VHSR-Very High Resolution Data

NTFP-Non-timber forest products

UNFCC-United Nations Framework Convention on Climate Change

IPCC-Intergovernmental Panel on Climate Change

ENFI-European National Forest Inventory

USGS-United States Geological Survey

EPA-US Environmental Protection Agency

NASA-National Aeronautics and Space Administration

NOAA-National Oceanic and Atmospheric Administration

GIS-Geographical Information System

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EXECUTIVE SUMMARY

Information exchange, collaborations, and networking opportunities about the national forest monitoring and assessment (NFM) process, and about national forest inventories (NFI's) in particular, is lacking in the South and South-East Asia region. The Regional Exchange Workshop on Forest Monitoring and Assessment was organized to address this need by bringing together NFI practitioners from 14 countries to share their experiences and learn from one another about common challenges and innovative solutions for improving NFI's. In total 70 participants were present, including high-level government officials, technical experts and academicians. The workshop was organized by the Bangladesh Forest Department with technical support from the Food and Agriculture Organization of the United Nations and SilvaCarbon, and financial support from USAID.

The workshop was broken down into three sessions: 1) NFI implementation, 2) use of NFI data for national plans and monitoring, and 3) NFI program sustainability and institutionalization. NFI practitioners from each country gave poster presentations about the status and challenges of NFI implementation. Experts presented on topics ranging from technologies and methods for efficient field data collection to addressing non-sampled plots. Participants got to know each other further through an interactive field visit that highlighted innovative technologies and methods for plot re-location, land feature determination, and non-destructive techniques for developing allometric equations.

Participants engaged in thoughtful discussions about issues surrounding the three session topics, resulting in key recommendations for improving the NFI process. Some highlighted recommendations include creating a dedicated team for quality control of NFI data, raising awareness among relevant stakeholders about the use of NFI data for national planning and decision-making purposes, and strengthening data sharing arrangements for supporting national forest monitoring. The interactions facilitated the beginnings of a regional network and collaborations on products to advance the region's ability to provide accurate, multipurpose and long-term information about forest resources. Three products in particular were identified for immediate future follow-up: 1) an atlas describing and comparing NFI's in the South and Southeast Asia, 2) a publication that provides guidelines for reporting and addressing large non-sampled areas in NFI's, and 3) a proposal to support further regional exchange and in particular to promote multipurpose NFI's for supporting decision making processes in sectors related to forestry.

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1. INTRODUCTION

1.1 Background

The assessment of forest and natural resources is essential to inform policy makers on the state and condition as well as the management of their resources in order for them to make informed decisions on how to ensure the long-term sustainability of the goods services as well as the resilience in the context of climate change they provide. National forest monitoring and assessment (NFM) provides the information countries need to manage their forests sustainably and meet national and international reporting requirements. The forest monitoring process includes data collection, analysis, and dissemination to a variety of stakeholders, and is shaped by country-specific monitoring needs and environmental conditions. This process also typically uses a national forest inventory (NFI) as the data collection tool that drives other NFM activities.

Countries in South and South-East Asia developed different systems for monitoring their forest resources, which differ in term of historical, technological, and biophysical as well as socioeconomic aspects. In consequence, objectives and purposes of forest monitoring differ among countries. While South Asian countries tend to consider all types of land including agricultural and tree resources outside forests, Southeast Asian countries tend to consider forestland only.

Despite the importance of forest conservation and management, both at national and regional levels, for resolving issues related to climate change, land degradation, socioeconomic development, or biodiversity conservation, among others, forest monitoring approaches and systems in countries suffer from problems that limit their ability to consistently and reliably inform relevant decision makers in government, industry, civil society and other sectors.

These limitations relate commonly to:

- Problems of institutionalization and limited availability of national resources to ensure the sustainability of NFI's and NFM systems over time,
- Limited consideration of national forest monitoring systems to contribute to sustainable production and resilience in the context of climate change;
- Lack of capacities for data analysis and information use for decision-making, monitoring, evaluation, statistics collection, and reporting;
- High costs, capacity gaps or other limitations to access information and knowledge on the use of innovative and efficient technologies for forest resource monitoring and assessment, and,
- Limited opportunities to knowledge and information exchange between and among countries with similar forest conditions and dynamics to facilitate the identification of feasible and effective methods of measurement, analysis, storage and dissemination of forest information.

1.2 Objectives

The overall objective of the workshop was to facilitate the exchange of information and experiences about forest monitoring and assessment from different countries. The workshop aimed to identify existing challenges, and exchange best practices amongst participants on strategies for overcoming challenges. Specific objectives included: the establishment of a regional network for addressing future NFM needs, begin collaboration on joint products, overcome challenges related to the three NFM topics. It was anticipated that the activities of the workshop would stimulate creative thinking about how NFI's could be adapted for multiple purposes, such as monitoring commercially important timber resources or providing information for responding to environmental crises. Additionally, participants were challenged to improve capacity building, NFI awareness, inter-ministerial coordination involved in the implementation of NFI.

1.3 Participants

There was a total of 70 attendees, including 21 participants from Bhutan, Cambodia, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand and Viet Nam (Appendix 2). Each participant represented a ministry or university responsible for forest inventory in their country. For example, participants from Bangladesh included the additional secretary and deputy secretaries of Ministry of Environment and Forests, senior officials of the Bangladesh Forest Department, faculty members of Chittagong University, Shahjalal University of Science and Technology, Khulna University and officials of FAO, USFS and USAID. A professional facilitator, Taya Levine, also attended and had a large role in facilitating the outputs of the workshop.

1.4 Overview

To engage participants to critically think about recommendations for addressing limitations in the NFM process, workshop organizers planned activities and working groups based on key topics and sub-topics that served as the platforms for discussion points. Before the workshop, selected participants were asked to complete a questionnaire that collected information about their country's NFI, including number of plots, data access policies, uses of remote sensing data, number of dedicated NFI staff, etc. The results from the questionnaire were then compiled and presented at the start of each session to give an overview of session topics.

The three topics formed three sessions which included three speakers each, plus a short overview presentation at the beginning of the session. The speakers were selected based on their expertise in the sub-topic area. After speaker presentations, a short question and answer period followed. Next, the participants were then divided into 6 working groups (2 working groups per sub-topic) so that there were between 8 and 10 participants per working group. The working group were distributed a list of sub-topic questions for which they were asked to provide recommendations to a variety of NFI stakeholders (i.e. national decision makers, national partners, and international partners). Each group selected a note-taker and presenter for reporting out their discussion results. Almost all the participants had some role in presenting results in addition to their role for providing their expert recommendations, making the process truly interactive. Complete notes about the recommendations and question and answer period are included in Appendices 3 and 4.

The closing session was dedicated to presenting a summary of all the recommendations provided by the participants and future work. The workshop objective to collaborate on NFI products was discussed. Three products in particular were identified for immediate future follow-up: 1) an atlas describing and comparing NFI's in the South and Southeast Asia, 2) a publication that provides guidelines for reporting and addressing

large nonsampled areas in NFI's, and 3) a proposal to support further regional exchange and in particular to promote multipurpose NFI's for supporting decision making processes in sectors related to forestry.

Below is a brief overview of the activities and topics discussed.

Country NFI experiences (Day 1)

- Ice breaker to learn about the interests of other, including their expectations of the workshop
- Poster session where each country presented about the challenges and highlights of their country's NFI.

NFI implementation (Day 2)

- Technologies and methods for efficient field data collection
- Ensuring data quality and Quality Assurance & Quality Control
- Addressing large non-sampled areas in National Forest Inventories

Use of NFI data for national plans and monitoring (Days 2 and 3)

- NFI for forest management planning
- NFI for FREL
- Addressing domain issues with sample-based estimation in NFI's

NFI program sustainability and institutionalization (Day 4)

- Strengthening institutional arrangements to support NFI
- Justifying long-term support for NFI
- Technology and communication to improve NFI data dissemination and reporting

2   SUMMARY OF THE FIRST DAY

2.1   Introduction to the regional workshop

Zaheer Iqbal, National Program Coordinator of the Bangladesh Forest Department, welcomed the participants and thanked all those who were gathered to make the workshop a success. He gave a small brief to the participants about NFI implementation in Bangladesh and talks about new technologies and innovations in BFI. Zaheer told everyone the objective of the workshop is to exchange technologies, views and ideas among each other. He expressed hope that a regional platform would be established through this workshop.

Rakibul Hasan Mukul, Conservator of Forests of the Bangladesh Forest Department also gave a welcome speech and told the participants that this workshop was designed to share knowledge of National Forest Inventory. He told participants that the Bangladesh National Forest Inventory was designed in a very efficient way and participants were gathered here to share and discuss the strength of NFI, its importance and other technologies.

Matieu Henry, Chief Technical Advisor of FAO, in his introduction speech he reiterated the need to reactivate the regional network (for NFI) that is already existing. He also mentioned how the NFI can be used for both economic purposes and for decision making in these times of environmental crisis. The role of NFI is to contribute to forest management and resilience of the ecosystem. There are plenty of new technologies and

steps should be taken to make them more feasible and adaptable. NFI is a resource intensive process and in the workshop, there will be discussions on the use of NFI data.

Patrick Meyer of USAID, thanked USFS, SilvaCarbon, USAID, FAO and Bangladesh Forest Department and presented a small brief on USAID's work in South and South-East Asia. Asia has set an example of how conservation and development can be done simultaneously. He mentioned how forests play a critical role in maintaining the livelihoods of local communities. Governments across Asia are using new tools to overcome the challenges being posed by natural hazards and NFI is one of those tools.

Ashraful Haque, Coordinator, SilvaCarbon, welcomed everyone to the workshop. He said, "this was a wonderful opportunity for us to exchange ideas and share knowledge".

2.2 Country poster session

All participating countries gave poster presentations on NFIs in their country. In the poster presentations, each country gave an overview of their NFI methodologies, objectives, major challenges and uses of NFI data. For most of the countries, the main objectives of the NFI were to come up with effective forest management plans, to determine land use and land cover change, estimate aboveground biomass, carbon sequestration and support biodiversity conservation activities. When it came to challenges, most countries mentioned that inaccessible plots, financial constraint, incomplete or poor data sharing mechanism and need for institutionalization were their main concerns.

Some participants shared their observations following the poster presentations:

Dr Mohammad Al Amin, Professor, Institute of Forestry and Environmental Sciences, Chittagong University: (Observation from the poster presentation of Lao PDR) There is a system/option of floating a plot in the design whenever there are inaccessible areas. If there is an inaccessible area, you should float the center plot, and another two plots to other location of same forest class.

Adam Gerrand, NFI, FAO: I saw this issue being highlighted by only one country, but I think it is an issue in all countries. I will call it safety, it was just on one poster and unfortunately in that country one person lost their life in doing the National Forest Inventory. We need to keep in mind, this job is risky and important and people's lives are precious and we need to do as much as we can to train people and make this job safe.

Secondly, I really liked the one, also from Lao, where they did an estimate of the cut stumps, if they found a plot had been logged, they estimated the size of the stump and tried to guess from some equations what the forest might have been. I know it is a very uncertain thing but if you do that, at least quantitatively in a proper survey like this, it could give you some estimate of the extent or quantity of illegal logging. Or it could be official, approved logging. Many countries measure the stumps, but they do not do this assessment of what would have been standing, so that was very interesting.

Ms Mariam Akther, Forestry Officer, Bangladesh Forest Department: One thing I learned was from Sri Lanka, they institutionalized their inventory. This is very interesting for me, because we are struggling in Bangladesh to get our NFI institutionalized.

Lobzang Dorji, Chief Forestry Officer, Bhutan: All thirteen countries are using different software to run their analysis. So, I was wondering maybe in the future if we have a common platform, maybe if we had one system or use one uniform software. Maybe the same R-script could be used by all countries.

3   SUMMARY OF THE SECOND DAY

3.1   Session 1: NFI Implementation

3.1.1   Overview of Survey Data by Gael Sola (FAO)

Mr Gael Sola presented an overview on NFI of the regions. The number of NFIs implemented by countries in South and South-East Asia was shown. All countries have implemented at least one NFI. Meanwhile, Sri Lanka had implemented a total of six NFIs. Between 2016 and 2018, five countries have implemented their NFIs. The presentation also showed the numbers of land covers inventoried and number of classes in different classes. The number of NFI plots surveyed by the different countries was shown. The presentation showed use of remote sensing was highest for land cover area statistics. Along with that use of allometric equations and growth models and Quality Assurance and Quality Control of the countries are also shown.

3.1.2   Technologies & Methods for Efficient Field Data Collection, presented by Zaheer Iqbal (BFD)

The objectives of the NFI is to provide information on status and trends of forest and tree resources, provide a baseline information for national forest monitoring, assist in national scale management planning, policy decisions and international reporting requirements including UN-REDD and identify links between forest resource use and forest status to assist in valuation of ecosystem services.

The inventory Zones of Bangladesh are Hill, Coastal, Village, Sundarbans and Sal. Bangladesh has a total of around 1858 number of plots across the country. The technical Design uses a cluster of five circular sub-plots. For Sundarbans forest, a cluster of 3 sub-plots were used. Field Inventory is not yet completed. For ensuring quality data 5 Quality Assurance and Quality Control (QA/QC) teams has been formed. There are four members in each QA/QC team. 10 days training was arranged for all team crews in early November of 2016. Special Training was provided to QA/QC members. Only 132 plots remain unmeasured in 3 hill tracts districts. Some of the tools and equipment used for data collection and sharing is also shown: Handheld GPS receiver, Tablet (Rugged Panasonic) and Open Foris Collect (BFI Customized), Laser Ranger/Range finder, Distance Measuring Equipment (DME), Suunto Clinometer among others.

3.1.3   Ensuring Data Quality, Quality Assurance and Quality Control by Heather Hayden (USFS)

Explanations were provided on what is Quality Control and Quality Assessment. Quality control is an operational techniques and activities that control the data acquisition process (use of standardized field protocols)) and Quality Assessment is a process to evaluate and assure the quality of the data in an objective and quantitative manner). It is critical to train the central QA specialists and all field crews at the same time but both QA specialist and field crew should receive the same training so field protocol and data collection is done would be same throughout the whole country. Emphasis should be given on safety, protocol, clarifications to the field guide and changes to the data collection software and equipment. Heather also mentioned the need for hot check (immediate results back) and cold checks (check throughout the season). Everyone was told to ensure communication when the QA crew goes to the field and it is also very important throughout the whole inventory. A clear reporting protocol is required and is important because the crew can get feedback and know whether what they are doing is right or wrong. The importance of a manual is also presented. Updating the manual does not necessarily mean changing data items collected but it is important to clarify unclear sections for field crews. A manual also establishes Measurement of Quality Objectives (MQOs). Her recommendation of best practices: a dedicated QA team is necessary, invest the time and money, and if a good QA team is not there then quality of data cannot be assured.

3.1.4   Addressing large non-sampled areas in National Forest Inventory by Kristofer Johnson (FAO)

A brief overview of bias from non-sampled areas was discussed. What are inaccessible plots and why it happens was shown. Country examples of inaccessible NFI plots was shown in the presentation. A simulation of missing plot data in Pennsylvania, USA and consequences on biomass estimation was also discussed. Lastly methods for addressing inaccessible areas in NFIs was discussed. The presentation further detailed methods to address situations of non-sampled plots. Statistical inference designs for estimation population variance were suggested, for example, stratifying the inaccessible area and using lower plot density was suggested.

3.1.5   Summary of expert recommendations from working groups

3.1.5.1   Recommendations for technologies and methods for efficient field data collection (e.g. software tools, tablets, etc)

Some highlighted recommendations to national decision makers include promoting the use of new technology and software, promote data sharing, and supporting NFI designs that incorporate socio-economic data. For national partners, such as universities, other government organizations and NGO's, the recommendations were to collaborate with NGO's for collecting and integrating social data into NFI's., engage universities in training and capacity building of professional forest mensuration experts. For International partners (e.g. FAO, donors etc.) some recommendations were to provide financial support and training on technology transfer, facilitate regional knowledge and technological exchange, and share best practice data collection methods between countries. A complete list of recommendation is provided in Appendix 4.

3.1.5.2   Recommendations for ensuring data integrity (effective training, QA/QC, data cleaning, etc)

Some highlighted recommendations to national decision makers include ensuring timely allocation of funds, institutionalizing a dedicated QA/QC team, and documenting well data cleaning efforts. For national partners, the recommendations were to involve many partners in the NFI process and to ensure adequate training of field crews. For International partners – to support more regional knowledge exchange events and increase funding for improving the NFI process.

3.1.5.3   Recommendations for strategies to address inaccessible or difficult to access plots

Some highlighted recommendations to national decision makers include supporting NFI across all land, not just forestland (non-forest, protected etc.), place high priority on safety (land mines, conflict zones etc.), consider new technology solutions (drones, RS data, models etc.), and establish inter-agency/multi-stakeholder NFI collaboration platform. For national partners, partner with states/sub-national and contractors for efficiency, allow local communities to participate in NFI, needs training to ensure high quality data collection and maintain plot and data integrity, propose a guidelines document for addressing large nonsampled areas. For International partners, allow countries to make their own decisions about what is best practice and demonstrate benefits they are interested in poverty and livelihoods.

3.2   Session 2: Use of NFI data for national plans and monitoring

3.2.1   Overview of survey data by Mr. Tin Htun (Myanmar) and Ms. Nurhayati (Indonesia)

The presentation briefly shows the use of NFI data for national plans and monitoring and the institutions accessing NFI data. It also highlights the top three objectives of NFI and shares example of two countries - Myanmar and Indonesia.

3.2.2 NFI for Forest Management Planning in Indonesia by Tatang Tiryana (Indonesia)

The presentation discussed the role of NFI in Indonesia. The outputs of NFI, use of NFI data and limitation of the NFI system are also discussed. Sustainable management of forests requires reliable and updated data. In Indonesia, Forest management plan is not only institutionalized, it is constitutionalized. The presenter said that in most countries, the role of NFI is somewhat common. In NFI what is not integrated in socio-economic data. It is mostly limited to Biophysical data now. The presenter mentions how there is mandated to develop national forestry mandate and says that in Indonesia they update it every year. NFI supports REDD+ mechanism and Forest Reference Emission Level activities in their country. NFI supports their forest management planning. Forestry enterprise: is a private company-- maybe from outside or so on. Some companies are trying to restore forest data. In FMU and Forestry enterprise, it is mainly for forest area and land cover map. Limitations of NFI are that they lack information on biodiversity and there is a technical problem as well. An example of that is in Indonesia botanists are not very abundant and it is difficult to identify species.

3.2.3 NFI for FREL by Nguyen Dinh Hung (Viet Nam)

In the presentation, the presenter introduces the NFI of Viet Nam. FREL/FRL introduction and shows a case study of using NFI for FREL/FRL development in Viet Nam. The presenter also discussed further improvements of NFI for FREL. The NFI in Viet Nam has been named as "National Forest Inventory, Monitoring and Assessment Program" (NFIMAP) and has been implemented since 1990 in 5-year cycles by FIPI. So far four cycles have been completed and working is going on of Cycle V which will be completed in 2020. There were two main components of the Viet Nam NFI - they were Forest cover maps generation and Forest inventory. Forest Reference Emission Level (FREL) and Forest Reference Level (FRL) are benchmarks for assessing the performance of REDD+. FREL includes deforestation & forest degradation and FRL: includes reforestation & forest restoration (i.e. enhancement of C stock). For further improving NFI for FREL, the presenter suggested to develop forest cover maps based on previous maps to increase consistency and reduce artifact changes and to generate time-series information on forest and land use transitions.

3.2.4 Addressing domain issues with sample-based estimation in NFIs by Luca Birigazzi (FAO)

The presentation started with a brief introduction. Country-specific estimates of carbon coefficients (emission factors) are required to compile national greenhouse gas inventories (GHGI) under the UNFCCC and, in the context of REDD+, for developing Forest Reference Levels (FRLs) and for the reporting of REDD+ results-based actions. Different emission factors have to be estimated for each of a number of land use categories and of various other land subpopulations, typically defined according to climatic zone, forest type or management practices. The presenter then showed some potential issue in survey sampling, which are non- response, under coverage, over-coverage (domain estimation). The presentation then moved on to show a decision tree for the choice of the estimator to be used in forest surveys to draw conclusions about population sub-groups created after and (independently) of the sample selection.

4 SUMMARY OF THE THIRD DAY

4.1 Session 2: Use of NFI data for national plans and monitoring (cont.)

4.1.1 NASA's ongoing collaborations with SilvaCarbon in remote sensing, forest cover mapping, and satellite imagery by Nathan Thomas (NASA)

The presentation gave a short brief on the work done by NASA in relation to NFIs. They do remote sensing research and collaborative efforts in remote sensing of forest structure and carbon storage and work on

enhancement of knowledge on international reporting. They work on strengthening of forest inventory capability of stakeholders, reinforcing capacity of young professionals for forest monitoring tools, support forestry remote sensing researchers and research into very high-resolution datasets. NASA has assisted in assessing Bangladesh forest extent using optical and radar sensors. Both together give fair idea what the work looks like in Bangladesh. Nathan mentioned there is a lack of field data in NASA's work and that the workshop was a good scope for collaboration. The presentation also talks about Tandem X. He shows how the shapes in Chittagong Hill Tracts changes. Which is because of how quickly the land topography changes as the land changes very quickly spatially.

4.1.2 Summary of expert recommendations from working groups (from second day)

4.1.2.1 Recommendations for streamlining the use of NFI data for national, sub-national, and international reporting purposes

Some highlighted recommendations to national decision makers include to make data accessible to relevant stakeholders so that everyone is using the same data and recognize NFI experts on forest issues and include them in national analyses. For universities to include NFI topics in their curriculum or research (research and teaching) and provide feedback using the NFI data for improvement. For International partners, to remember transparency in their own methodologies, provide clear guidelines for reporting, and support and assist in capacity building (e.g. technical expertise, technology, funding, expert exchanges/training).

4.1.2.2 Recommendations for streamlining the use of NFI data for forest management and investment plans

Some highlighted recommendations to national decision makers include sharing NFI reports to policy makers for protected area identification and delineation of productive forests, to document well data collection, analysis, and quality control methods in country investment plans. For universities to perform need based research and promote using NFI data for multiple purposes. For International partners, to provide resources and technologies for developing countries.

4.1.2.3 Recommendations for integrating remote sensing with NFI data for meeting (sub-) national goals, plans, strategies, etc

Some highlighted recommendations to national decision makers include to make data access less bureaucratic and available at minimum charge, to share data amongst ministries and agencies while ensuring credit to the data provider, understand how to use maps and the limitations of remote sensing data (i.e. don't assume that remote sensing solves all the problems), and to support high resolution data that can be used for multiple sectors.

For national partners, to provide accuracy assessments (map validation) of products to national decision makers, propose more research calls for developing techniques that integrate remote sensing and NFI data, and do more independent research in the area of mapping forest attributes. For international partners, to share NFI costs with country partners and purchase high resolution data and wall to wall remote sensing data, provide training for the use of the data, and develop tools that are better and easier to use for forest managers (not programmers)

4.2 Field Exploration and observations

All participants were taken to the Lawachara National Park, a biologically rich forest, as it is located on the high rainfall bio-geographic zone with evergreen and semi-evergreen forests. Lawachara National Park is in

Kamalganj Upazila of Moulvibazar District and is located nearly 160 km northeast of Dhaka and approximately 8 km from nearby Srimanagal sub-district. Local Divisional Forest Officer Mihir Kumar Doe was present at Lawachara NP to welcome the participants and provide them with a short brief about the NP. The NP was notified in 1996 as per the Wildlife (Preservation) (Amendment) Act, 1974, with a total forest area of 1250 ha. Participants were separated into groups and each group visited the demonstrations to learn about the different innovations, challenges and techniques involved in the Bangladesh Forest Inventory.

4.2.1 Plot Measurement

BFI plot consists of five and three sub-plots for Hill, Sal, Village, Coastal and Sundarban zones respectively. Each subplot, with a radius of 19m, consists of five nested subplots (except Sundarbans having three sub-plots). The following measurements are taken at plot level: location, land features. At the sub-plot level they are: down wood, soil, litter, seedlings, tree attributes etc. Data is collected using tablets and open foris collect and analyzed using R software. All data is archived and any modification of the data documented.

4.2.2 Locating plot center and DGPS/ RFID activities

Bangladesh Forest Department has collected field data from 1858 inventory plots distributed all-over the country in five different zones. Different challenges like land degradation, soil erosion, siltation, distortion of handheld GPS, possibility of witness objects removal and uprooting of metal bar may create problem in relocating inventoried plots in future. Strategies blended with technologies will help the forest department in relocating plot center in next inventory.

4.2.3 LCCS and Integration with BFI plots

Conventional system of assigning land classes (such as forest land, cropland, grassland etc.) in the field are often vague or lacks appropriate definitions to allow their comparability with classification systems used in different maps. The BFI methodology does not rely on such pre-defined land cover class names. Instead, a detailed description of the objects identified within homogeneous land area are recorded using the Land Cover Meta Language/Land Cover.

4.2.4 Socio-economic survey

The socioeconomic survey of the BFI provided information for 8 criteria and 79 indicators which assesses the relationship between people and tree and forest resources. The overall objective of the socioeconomic survey is to provide a better understanding of the dynamics between supply and demand of forest goods and services for improving forest management, supporting national targets and strategies. Questionnaires covered diverse topics, including demographic information and biodiversity and conservation and disturbances, degradation and resilience and economics and livelihoods and progress towards sustainable forest management.

4.2.5 Non-destructive sampling for developing allometric equations

Development of allometric equations for biomass estimation requires extensive planning, fieldworks, sample analysis in the laboratory, and data analysis. Typically allometric field activities are mostly destructive, difficult and expensive to repeat. Sometimes, this destructive method of biomass measurement is not possible for countries like Bangladesh where moratorium has given on felling of trees from the forest areas. Development of allometric equation using semi-destructive method involves trimming of some smaller branches (diameter<7cm) and measurement of base diameter of both trimmed and untrimmed branches. Biomass of bole and bigger branches (diameter>7cm) are measured from their volume and wood density. Semi-destructive method for the development of allometric equation contains seven steps from planning to final equation and the steps areas. Semi-destructive method for the Development of Biomass Allometric Equation in Bangladesh has seven steps: a) preparation of the field work, b) Field measurement I c) Field

measurement II d) Field measurement III e) Laboratory analysis f) Data compilation g) Selection of best fit equation.

5 SUMMARY OF THE FOURTH DAY

5.1 SESSION 3: NFI program sustainability and institutionalization

5.1.1 Regional application of LCCS3 by Rashed Jalal (FAO)

The presentation addressed how two seemingly different objects become comparable based on their attributes and the ways in which LCCS3 was developed. The talk was about the different definition of forest changes in different countries and how the definition of land cover maps changes over time. The presentation shows that LCCS is a software to apply the LCML. The use of LCCS and LCML approach is to standardize the attribute terminology. We need at least one LCML element to be able to make a land cover map. Users can define their number of classes and make maps as per their desires. Land cover maps are being used to assess availability of wood fuel and to see where plantations are suitable.

5.1.2 Overview of Survey Data by Lobzang Dorji (Bhutan), MARK DV. DE CLARO (Philippines)

The presenters outline the human Resources involved in NFI, they talked for the need to clarify who are permanently employed and who are temporary staff? The presentation details on who are working on what, like GIS, remote sensing, Field data, data analysis, or Quality control and Assurance. Philippines lays out how their labor division works. The presenters discuss that there is also a problem with technology.

5.1.3 Strengthening of institutional arrangements to support NFI by Laurent Saint-Andre (CIRAD/INRA)

The presenter discussed on The French National Aboveground Carbon Stock assessment, European forest biomass and carbon stock assessment and the lessons learnt from this process. In general, a national level forest inventory is not a standalone process. Laurent mentions how the NFI has been constitutionalized in 1950s. Any crew of the NFI can go anywhere in France to make measurements provided the data is not used for taxes. Raw data is freely available, but will not get plot location, to protect ownership. The presentation discusses new technologies like the XyloDenMap to project on wood density. The presenter further said that institutional arrangements enhance NFI potentialities, funding is very important, dialog between forest research, management, inventory is crucial (for policy, practices and knowledge building) among other things.

5.1.4 Justifying long-term support for NFI by Chip Scott (USFS)

The presentation outlines the US experience with support, justification for national forest monitoring, voluntary guidelines for national forest monitoring, principles and foundation elements. The justification for NFI talks about how different groups use NFI, like universities for research, industries to know where and what to harvest. The voluntary guidelines on National Forest Monitoring is available on FAO website. The presenter also urges the need to bring together your partners and users.

Recommendation by Chip Scott: band together stakeholders, increase the base (number of people) who use the data so that they can lobby the government/ other agencies to get the funding. If your data is in demand, it will be easier to get the funding.

5.1.5 Technology and communications to improve NFI data dissemination and reporting by Dr Upul Subasinghe (Sri-Lanka)

The presenter emphasized on the need to produce and disseminate timely and high-quality statistical data and or information to meet the user's various and changing needs. He talks about the different users of data. There are public and private users. A case-study of Sri-Lanka is shown in the presentation and then movds on to

challenges such as rising needs with national and international requirements, unequal development of NFI systems and new data collection methods.

5.1.6 Summary are expert recommendations from working groups

5.1.6.1 Recommendations for strengthening institutional arrangements

For national decision makers, the recommendations were to establish a recruitment process to hire qualified, permanent NFI staff / provision of continuous trainings, allocate sufficient funds for the NFI activities and identify co-funding opportunities, and understand the importance of using NFI data for management and policy making and national planning. For national partners, to give access to NFI data to universities, other research organizations, government and non-government agencies, and participate in capacity building trainings for mapping skills. For International partners, to provide or train in data sharing platforms.

5.1.6.2 Recommendations for justifying long-term support

Some highlighted recommendations for national decision makers were to establishment of legal basis for NFI by forest law, provide dedicated IT support to NFI, and allocate sufficient funds for the NFI activities and identify co-funding opportunities for understanding the importance of using NFI data for management and policy making and national planning. For national partners, to develop ownership of the NFI by engaging universities, and to make NFI data easily accessible.

5.1.6.3 Recommendations for improving forest information systems

Some highlighted recommendations for national decision makers included to clarify the use of NFI data, and provide clear legal framework and mandates for NFI. For national partners, to do MoU amongst the stakeholders, and institute a feedback mechanism for exchanging opinions between data producer and users. For International partners, to facilitate regional gaps and errors at regional or international workshop, capacity building on advance technology transfer, and provide assistance for land cover mapping and classification (e.g., LCCS).

5.1.7 Problem analysis and synthesis for future work

NFI's of the future must aim to meet a variety of societal needs. Therefore a vision statement is proposed that will focus on future efforts for improving NFI's:

Vision for 2030: how the national forest monitoring and assessment should look like?

National forest monitoring and assessment will meet future challenges related to increase human pressure on forest resources, urbanization, land use change, plant dieback, wildlife-human conflicts, soil fertility losses, access to energy, invasive plants, health, food security

National forest monitoring and assessment will be integrative, multi-sources (from different stakeholders) and multipurpose (for different sectors) and contribute to landscape and forest management and conservation, people's livelihood

Additionally, some countries were selected for offering country-specific visions of their future NFI's:

India: NFI will be teached in forestry colleges and institutions. NFI will contribute to certify forest products. Activities like CAMPA will helps to strengthen NFI.

Bhutan: Monitor the multi resources assessment not only confirming to traditional forest parameters

Bangladesh: Institutionalization of NFI and capacity building of the involved personnel, and financial commitment from government

Malaysia: forest related issues in the forest sector are fully integrated into decision making processes of land use planning and development

Indonesia: NFI should provide more comprehensive data and information on forests and landscape for promoting environmental benefits while increasing socio-economic benefits

Sri Lanka: Streamlined to strictly monitor forest cover and health and to maintain forest dynamics to control offenses and to aid in biodiversity protection, erosion control and water quality minimizing the impacts from other sectors (agriculture, industrial and and human settlements) while providing benefits (Timber, NTFP etc.)

6   CLOSING REMARKS

6.1   Summary of workshop outputs and discussion of action points by Adam Gerrard (FAO) and Rosaizan Haryani Binti Rosli (Malaysia)

In the presentation a complete overview of the workshop is provided. About 70+ participants from 13 countries joined. There were 11 expert presentations. Using poster presentations, the NFIs of 13 countries have been summarized. Recommendations have been laid out for national decision makers, national partners and international partners to help in field data collection, data integrity, on difficult to access plots. Most of the recommendations were for the national partners. Recommendations on setting a vision for NFI 2030. The presenters suggested a few action items to be produced from the workshop including: 1) a publication to be titled: "An overview of forest monitoring and assessment in South and South-East Asia", 2) develop a regional project proposal to strengthen NFI, and 3) a publication about addressing issues with large nonsampled areas.

6.2   Closing session

Zaheer Iqbal of the Bangladesh Forest Department welcomed everyone to the closing session and thanked all the participants for coming up with innovative solutions to implement NFI seamlessly. Mohammad Shafiul Alam Chowdhury, Chief Conservator of Forest, Bangladesh was the Guest of Honor in the program. The program was chaired by Md Mozahed Hossain, Additional Secretary, Ministry of Environment and Forest. Other special guests in the closing ceremony included Patrick Meyer, Science and Environment Advisor, USAID, Justin Green, Program Specialist, USFS, SilvaCarbon, Nur Khandker, Assistant FAO representative and Matieu Henry, Chief Technical Advisor, FAO.

6.3   Other remarks about participant experiences

"I have learnt many new things from the workshop. Especially how systematic the NFI process in Bangladesh is. I will surely apply this knowledge in my country,"-Rosaizan Haryani Binti Rosli, Senior Assistant Director, Inland Forest Management, Forestry Department Peninsular Malaysia.

"Overall the workshop was amazing. Especially the field experience. I learned about the semi-destructive sampling technique to develop allometric equation. Also the plot-design of Bangladesh NFI is very unique,"—Mr Somphavy Keoka, Deputy of Forest Survey Section of LAO PDR.

"The ongoing NFI is the first very comprehensive NFI. After completion of NFI and land cover monitoring activities Bangladesh will be in a position to prepare and submit regular

and reliable international reporting for national communication on greenhouse gases emission and FRL. I believe knowledge, trainings, methods, discussed and shared in this workshop could be of utility and help to all of us."—Shafiul Alam, Chief Conservator of Forests.

"*We wanted to have this regional workshop to learn more about everything that's been happening in the region, with the NFI work and to learn from the successes and the challenges. Having everyone come together in this way really proved that this was valuable and your presence has made this such a great workshop, it was amazing energy, it was so refreshing to both hear and talk about data sharing and institutionalization and moving to the next step which is collaboration and sharing information between countries so I thank everyone for participating and we look forward to where this will take us in the future with more collaborative work.*"—Justin Green, Program Specialist, USFS, SilvaCarbon.

"*The inventory design of Bangladesh NFI is very unique. The use of technology—RFID and DGPS—is also something very innovative. Another key thing I learned is changing the plot design. In Philippines, we use rectangular plot, which is not that efficient. Use of circular plots seems like a better design*"—Mark De Claro, Senior Forest Management Specialist, Forest Management Bureau of the Department of Environment and Natural Resources of The Philippines.

"Regional NFI experts are together here in the Regional Workshop to share their knowledge and experiences that will strengthen future networking for the improvement of NFI." —Md Mozahed Hossain, Additional Secretary, Ministry of Environment and Forest of Bangladesh.

" a great opportunity to exchange knowledge between countries and better understand what others do, where we are and where are the gaps. This workshop provided an opportunity to strengthen collaboration betwen countries and discuss critical issues for forest monitoring such as data sharing and data accessibility" - Dr. Mohammed Azizul Hoque, Deputy Secretary, Ministry of Environment and Forests

7 APPENDIX

7.1 Appendix 1: Agenda

DAY ONE	
TRAVEL AND INTRODUCTION	
Timeline	Program
07.00 am - 12.15 pm	Travel to Grand Sultan Tea Resort, Sreemangal, Moulavibazar.
01.00 pm-02.00 pm	Lunch
02.00 pm - 03.20 pm	Opening Session Welcome (25 min): **Zaheer Iqbal** (BFD) **Rakibul Hasan Mukul** (BFD) **Matieu Henry** (FAO) **Patrick Meyer** (USAID) **Ashraful Haque** (SilvaCarbon) Introductions Activity (40min): **Taya Levine** (TRG) Background and Overview (15 min**)**: **Zaheer Iqbal** (BFD) and **Taya Levine** (TRG)
03:20 pm – 04:00 pm	Country Poster Session I
04:00 pm – 04:15 pm	Tea Break
04:15 pm – 05:00 pm	Country Poster Session II
05:00 pm – 05:15 pm	Debrief and Close: **Zaheer Iqbal** (BFD) and **Taya Levine** (TRG)

DAY TWO	
WORK SESSION I: NFI IMPLEMENTATION	
Timeline	Program
07.00 am - 08.30 am	Breakfast
08.30 am - 08.45 am	Overview of Agenda: **Taya Levine** (TRG)
08.45 am - 9.45 am	Overview of survey data (10 min): **Gael Sola** (FAO) Presentations: -Technologies and methods for efficient field data collection (15 min) **Zaheer Iqbal** (BFD)

	-Ensuring data quality and Quality Assurance & Quality Control (15 min) **Heather Hayden** (USFS)
	-Addressing large non-sampled areas in National Forest Inventory's **(**15 min) **Kristofer Johnson** (FAO)
09.45 am - 10:30 am	Group discussion and Q & A with presenters
10.30 am - 10.45 am	Refreshment Break
10.45 am - 1:00 pm	Working Group Sessions
01.00 pm - 02.00 pm	Lunch
02.00pm - 3:30 pm	Working Group Report Outs
03.30 pm – 3.45 pm	Refreshment Break

WORK SESSION 2: USE OF NFI DATA FOR NATIONAL PLANS AND MONITORING	
03.45 pm - 04.45 pm	Overview of survey data (10 min): **Mr. Tin Htun (**Myanmar) and **Ms. Nurhayati** (Indonesia)
	Presentations:
	-NFI for forest management planning (15 min) **Tatang Tiryana** (Indonesia)
	-NFI for FREL (15 min) **Nguyen Dinh Hung** (Viet Nam)
	-Addressing domain issues with sample-based estimation in NFI's (15 min) **Luca Birigazzi** (FAO)
04.45 pm - 05.30 pm	Group discussion and Q & A with presenters
05.30 pm	Day Wrap Up: **Taya Levine** (TRG)

DAY THREE	
Timeline	Program
07.00 am - 08.00 am	Breakfast
08.00 am – 08.15 am	Overview of the Day: **Taya Levine** (TRG)
08.00 am – 08.30 am	Morning Talk: NASA's ongoing collaborations with the SilvaCarbon in remote sensing, forest cover mapping, and satellite imagery (30 Min) **Nathan Thomas** (NASA)
08.45 am – 10.45 am	Use of Data Working Groups
10.45 am – 11.00 am	Refreshment Break
11.00 am – 01.00 pm	Report Outs
01.00 pm – 02.00 pm	Lunch
02.00 pm - 05.30 pm	Forest Exploration - Lawarchara National Park Travel to the park (20 min)

	Welcome to the Park: (10 min) **Mihir Kumar Doe** (Local DFO BFD)
	Demonstrations (5 groups; 20 min each; 10 min walking time): -Plot measurement (20 min) **Falgoonee Kumar** (FAO) and **Md. Sajjaduzzaman** (BFD) -Locating plot center and DGPS / RFID activities **Zaheer Iqbal** (BFD), **Rajib Mahamud** (FAO), and **Nandini Sarkar** (FAO) -LCCS and integration with BFI plots **Rashed Jalal** (FAO) and **Tariq Aziz** (BFD) -Socioeconomic Survey **Nikhil Chakma** (FAO) -Non-destructive techniques for developing allometric equations **Dr. Mahmood Hossain** (Bangladesh) and **Mariam Akhter** (BFD) Travel back to Grand Sultan, 20 min

DAY FOUR

WORK SESSION 3: INSTITUTIONALIZATION / SUSTAINABILITY OF FOREST MONITORING

Timeline	Program
07.00 am - 08.00 am	Breakfast
08.00 am - 08.15 am	Overview of the Day: **Taya Levine** (TRG)
08.15 am - 08.45 am	Morning Talk: Regional application of LCCS3 **Rashed Jalal** (FAO)
08.45 am - 9.45 am	Overview of survey data (10 min): **Lobzang Dorji** (Bhutan) and **Mark Dv. De Claro** (Philippines) -Strengthening institutional arrangements to support NFI (15 min) **Laurent Saint-Andre** (France) -Justifying long-term support for NFI (15 min) **Chip Scott** (USA) -Technology and communication to improve NFI data dissemination and reporting (15 min) **Dr. Upul Subasinghe** (Sri Lanka)
09.45 am – 10.30 am	Group discussion and Q & A with Presenters
10.30 am - 10.45 am	Refreshment Break
10.45 am – 1.00 pm	Working Groups
1.00 pm - 02.00 pm	Lunch
2.00 pm – 3.30 pm	Report outs and Discussion
3.30 pm – 3.45 pm	Refreshment Break
CLOSING SESSION	
03.45 pm - 04.15 pm	Summary of Workshop Outputs and Discussion of Action Points: **Adam Gerrand** (FAO) and **Rosaizan Haryani Binti Rosli** (Malaysia)
04.15 pm - 05.30 pm	Remarks **Matieu Henry**, Chief Technical Advisor, FAO **Nur Khondaker**, Assistant FAO Representative **Justin Green**, Program Specialist, USFS SilvaCarbon **Patrick Meyer**, Science and Environment Advisor, USAID **Md. Mozahed Hossain**, Additional Secretary, MoEF

	Mohammed Shafiul Alam Chowdhury, Chief Conservator of Forests, BFD
06.30 pm-09.30 pm	Cultural Programme & Dinner

DAY FIVE	27
TRAVEL	
Timeline	Program
08.00 am - 01.30 pm	Travel to Dhaka

*() name of participants country

7.2   Appendix 2: List of participants

ID	Participant Name	Country	Designation	Organization	Email
1	Mr. Lobzang Dorji	Bhutan	Chief Forestry Officer	Forest Resources Management Division, Department of Forests and Park Services	Lobsangdoj(a) gmail.com
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70	Abida R Chowdhury	Bangladesh	(Rapporteur)	SilvaCarbon	NA

7.3 Appendix 3: questions and answers

SESSION 1: NFI implementation

7.3.1 Questions and answers from session speakers

Q. We found that if we give more effort to assess the plot biomass or the plot volume for say only 1.5 percent or 1.5 percent of the plots, we found from Kris' presentation that 7.5% unmeasurable plot is actually just part of the mean. If the percentage is less, it does not significantly affect the mean so what to do? And my opinion, for the inaccessible plots we have measured the crown cover, so can we correlate the crown cover with the plot biomass or the volume to measure the plot biomass and volume?

Ans: I think your question is what is the threshold for, when it becomes the problem, if it affects the mean or not, the non-sampled area and if your non-sampled plots are more or less randomly distributed in the area, then it is probably not a problem. The problem is when you get these large areas that are continuous. Then there is no real way to say it is 7% or 10% of what will affect the mean. You do not know. That is the worst part of the problem, you do not know if it is going to be a problem.

And the next question was about crown cover, I have seen some models that work well to predict biomass. I personally do not prefer crown cover, if you get the height, it would be trustworthy. Crown cover is something I do not find very reliable, if you get the height it is more reliable. It really depends on the forest type.

Q. I am working in Sundarbans region of India and would like to know what kind of strategies and planning and safety measures you are adopting during data-collection work in Sundarbans?

Ans: We take at least one armed forest guard with us to collect data. They stay and work with us for 24hrs. For navigation, there are people dependent on Sundarbans-- such as honey collectors, fishermen, crab hunters etc, they are hired as daily workers and we take them with us.

Q. What is the status of non-timber forest products? Are you collecting information on that? (Question for Bangladesh Forest Inventory)

Ans: Yes, we consider the non-timber forest products in our inventory design. We are collecting information and gathering data for bamboo, and any other NTFP. For Sundarbans, it is golpata, nypa fruticans, shrubs or herbs, etc. we are not collecting information about vines and climbers.

Q: The first question relates to quality control and quality assurance. How you ensure quality of data, in species identification across the team and how the training is conducted prior to data collection and so on. My second question is about GEDI, my team here wanted to understand more about GEDI. How can we access the data?

Ans: I think the question was about including 90 percent of the tree species into the OpenForis right? Yeah, we are using OpenForis for data collection and while customizing we have gone through all the forest species, forest trees and shrubs and NTF found in Bangladesh from the National Herbarium and other sources and included their local name, common names and so on into the OpenForis tools. That is why I told that we have covered almost 80-90% of the tree species into the system of the OpenForis platform. Even then there are some unidentified trees, so the teams working in the field collect those samples and send them to the herbarium.

Ans: The GEDI mission is supposed to start next year. So, 2018. From what I understand is that they have some great products like tree height and biomass to a 1m resolution. I am not sure if the raw data will be available. I have talked about GEDI, yes. But there are other missions out there as well. Tandem x for example.

Q. How do you determine acceptable and unacceptable error? Second question is, if it is okay to sample another plot near an inaccessible area if it of the same forest stratum?

Ans: So you want to change the location of the plot based on the same forest type? If the conditions are very similar. I think it would be alright. Statistically it should not make much of a difference.

Adam Gerrand wanted to know if you change the location of a plot, do you also change the grid point in your record?

Ans: (Kris) you mean the geo-reference? You have to change it for sure, yes.

Q. What is the basis for determining Cold-check...whether it should be 10% or 5?

Ans: (Heather) We generally use what is established for the data collection design. In general, 10 percent has been used. We used 10 percent. It is not just 10 percent of cold, it would be a mixture of hot and cold. To be honest, the main part is to make sure you are visiting all your crews and to make sure you are doing one to two percent of blind plots.

Ans: (Zaheer) He asked about the acceptable and unacceptable error for plot revisiting. After collecting all the data from the first cycle, an expert went through the R Script QA/QC. Then we analyzed all the data, (me, Akther and experts from FAO) and decided to go revisit 54 sample plots. We found that some plots were missing geo-reference that is an unacceptable error. Also in one case we saw for DBH data, the rounded data is there for around 10 or 12 of the 20 trees measured, I do not know how it happened.

Q. I have a question regarding non-sampled plot. In the presentation we saw how to assess non-sampled plots using remote-sensing. But I have one example, like very recently, I visited Sangu Reserve forest. So on using high-resolution data on the first day, we visited one plot. It had a very good distribution of trees, many different species, and dense vegetation. So, having the same kind of image, on the next day, we visited another spot, in the image it had very dense vegetation, but when we visited in person, the plot was barren. So, my question is using the satellite images, we may not be able to measure the biomass or other things. How do you address this kind of rapid changes in the plot?

Ans: Whatever maybe the situation that is what you should sample. Because you want a representation of not only the spatial variation but also the temporal variation. So, your question is if an area is cleared, would you maybe move the plot to another area and my opinion is you may not want to move it.

Q. What kind of software FAO is using for data collection? And the other question what sort of measures is the Bangladesh NFI taking for addressing inaccessible plots?

Ans: We use OpenForis collect for data collection. It is developed by FAO and is an open source software and we have customized this OpenForis according to our requirement. Secondly, we are still thinking about how to address inaccessible plots. We have found that the inaccessible plots will be found in the Chittagong Hill Tracts region for Bangladesh.

7.3.2   Technologies and methods for efficient field data collection (e.g. software tools, tablets, etc)

Q: Should use the same methods for data collection?

Ans: Yes, everybody should harmonize data collection.

Q Why should the sampling intensity be same?

Ans: If the sampling intensity is the same, maybe then the data can be harmonized?

Different country has different plots. Myanmar has 13000 plots, whilst Bangladesh has 1858 plots. Forest situation and types are similar. We should optimize and should have common procedure for this same region. For the same objective, same forest type, why the sampling intensity should not be same.

Ans+: Actually we had some discussion. It should not be exactly the same. We need to come up with some sort of recommendation to understand what should be the sample size for particular forest type.

Q. What is the technical view of the experts on this topic?

Ans: Because each country has its own specificity, and accuracy, stratification and each country has its own sampling design. It essentially depends on what the required precision is, and what the budget is.

Adam: My experience is from outside the region. Australia. The core variables we wanted, and the core information we wanted to collect. We did not give them any methodology. We did not determine the method. It was more the outcome or the results we wanted. Consistent end result. Getting countries to do it in their own way. They should determine the variables, such as accuracy. Specify certain parameters so that we get the right end results.

7.3.3   Ensuring data integrity (effective training, QA/QC, data cleaning, etc)

Response: My question is to Dr. Alamin, you mentioned that QA/QC team should incorporate recommendations from the policymakers. But amongst policy makers there are two levels of policy, one is at the agency level and the other is in the institute level, which one are you talking about? This I ask particularly because if you are talking about the agency level, there will be a major communication gap to overcome. A: Thank you. That is a very good comment. As we mentioned, communication is a very important part for the quality control. At these two levels, forest department and ministry, there should be a synchronization of the policy decisions. We want emphasis on the involvement of the policy makers, from the top level to the agency level. There should be good communication and synchronization of the matters. This is key if we want a smooth communication and institutionalize the policy decisions properly.

7.3.4   Strategies to address inaccessible or difficult to access plots

Q: I found that both the subgroups insist to make the inaccessible plots accessible. If we are not able to go there at well), what will be the adjustment/assessment? If we cannot go, what the alternatives are? +Q: So did your groups actually talk about the options or alternatives?

Ans: Yes, actually one that, we could do research because it should be model based or in a mixed approach or hybrid approach. So, we need to identify according to the condition.

Ans: It is a question of cost. Because the government will not pay 20% of the cost to go to one percent of the area. If the reason you could not go is because of funding and extra costs makes it possible to access the area,

then go to other agencies, and show the importance of the area for water conservation, biodiversity or other purposes to be able to secure more funds.

SESSION 2: Use of NFI data for national plans and monitoring

7.3.5 Questions and answers from session speakers

Q. In your country, you have lot of hierarchy in each level. My question is how do you manage the things for decision making, how do you coordinate this decision making?

Ans: Decentralize the forest sector. These management plans made by the lower levels should be approved in the provincial level and then by the national level. There is conflict obviously.

Q. Your annual afforestation, that is huge, how did you do that?

Ans: Our govt concerned on this issue. We exploit much natural forest from 1970-1990. Now most of our forest is secondary forest. Now most of the area is shrub etc. This is a rehabilitation.

Q. How can you justify to your government, that we need to do forest inventory (Bhutan specific) Ans: When I started, forest area was almost 60% in Indonesia. Our first forest law was drafted in 1967. There was a revision of forestry law. The inventory was the main priority, without knowing the forest data, it is impossible to plan for further work and decision making.

Q. You have completed your NFI. How do you manage your data-sharing and transparency related issues?

Ans: In Viet Nam, to share the data, we must seek permission from the government. We should provide all of the data to the technical assistance team to ensure transparency.

Comment (Viet Nam): We prepare Forest cover map every five years. This map is generated independently by the concerned department. The map for 1995 and 2005 used resolution imagery. We developed the map independently. We made several efforts to improve the forest cover map. Improve the quality of the forest cover map.

Q. What is the edge-effect?

Ans: (Luca Birigazzi) So basically, the edge effect is, if you can monitor over the edge of the forest, the biomass is less, if you are more in the core then the biomass is more.

Q: In the first presentation, in a slide they said that, there was 2 countries with other objectives, but maybe we cannot follow these different/other objectives. In the objectives of NFI, across the countries, there was a category-OTHERS, but what were behind others (what consisted of others) was not clear.

Q. That is one question and another is regarding the Luca's estimations that is where we address domain issues? In our case, in Bangladesh, we are estimating biomass, carbon and other parameters based on land coverage based on forest zones. We have 5 zones. If we want to estimate those parameters based on administrative districts or divisions, I think we can follow your method, so, can we? (Luca) A: Yeah, sure, it is not really my method, but it is a well-known formula. You can get any kind of sub-division of your country. Of course, you need to be careful if what your domain then you risk the number of sample that is inside the domain. Then it does not allow a good estimate. So, the minimum number of sample that one should have is a matter of discussion, but at least it should be 10-20. (Gael) A: There was a list of 25 answer for the questions. 2 countries they did not choose all of the listings and one country put area of forest cover as a key objective, though it was not on the list, and the other country put research and two countries chose others.

7.3.6 Use of NFI data for national plans and monitoring

Q. It is about the collaborative inventory of inaccessible plots, if we fusion the optical and radar, is it possible to estimate the biomass? So, the question is about whether Lidar can help with the inaccessible plots?

Q. I am going to talk about the mangrove forests. In mangrove forest, for estimating the structure. You see there is low tide and high tide. If you estimate during low tide, you will get one height and if you estimate during high tide, you will get one height. Then I want to know, in this position, how will you adjust it? What is the accuracy in this estimation?

Q. You have shown some Tandem X data. How accurately can we estimate height as we know that Tandem X is expecting scattering phase interval and is there any difference between scattering phase interval and total height, particularly for mangroves?

Q. For tree species, if there is any slight difference between the time of acquisition because of wind and other things, temporal DEM correlation could happen. How good is tandem x in collecting data and synchronizing at the same time?

Q. Two participants ask about possible scopes of collaboration, one with Forest Department and another with Universities, individual researchers and so on.

Ans: With Radar imagery you, you essentially use two different scenes together and you correlate them. But if you have large time-gaps between the scenes acquired, you get something called temporal decorrelation. This can be something obvious, as how many trees removed, or something small like wind blowing the trees. With Tandem X, we very much limit the temporal decorrelation. One satellite sends and receives the signal, while another satellite behind it simply receives. They fly so close together, at a speed of about 500miles/hr separated by about half a mile or something like this. They fly so close together and so fast that the temporal decorrelation is limited. So if you had a single sensor, like if you remember the A-Sentinel. They collect data every four days, or every four to six days, you get a large temporal decorrelation. With Tandem X the temporal decorrelation is very small.

Answering to question about mangrove height:

Ans: For tandem x the wavelength is so small, you will get the approximate top of the canopy. You may not get exact the top of the canopy but you get much closer to the top of the canopy then L-Ban or so on. From what we have correlated with our Lidar data, the Tandem X shows a correlation of 0.98 something. So, it is comparable to the Lidar data. That's why we do not worry about the tide. We just take from the ground. We just assume the ground to be at zero because that is at sea-level and everything above that is Mangrove height. We do initial measurements based on the water height. But then you assume the topography of the mangroves is near zero.

Ans: If you have good ground data, you can link that to the remote sensing data and builds models on the relationship between the two. But then if you have inaccessible areas, you cannot reach, you can extrapolate the relationships elsewhere and you can apply them to areas you cannot reach. So that areas you cannot reach are not missing from your sample data already. So, if it is a species you already know of or if it is a certain height class you have already sampled, if there is nothing new about the area, you should be able to apply the models.

Ans: Surely, we are always looking to collaborate. These kinds of workshops are where collaborations are established.

7.3.7 Streamlining the use of NFI data for national, sub-national, and international reporting purposes

Q. During drafting of the NFI, documents should be shared. I am not sure how it should be done. You said data should be shared during drafting stage?

Ans: After the report is complete, you can give to many people. During the reporting process, and drafting stage, it is best to involve the relevant stakeholders, so that they can give their inputs during the drafting stage. After finishing the report, it becomes difficult to make changes to the data, if the stakeholder want to change to the data after finalizing the report.

Q. You want the partners to do QA/QC, how can policy makers can do QA/QC?
Ans: Forest Department can involve university people. We can choose one university or so on to get involved. An outsider can help with QA/QC as it means involving more stakeholders.

Comments: Participant: I found most universities already have courses on NFI in their curriculum, so I think that recommendation is not necessary, rather some capacity building would be ideal.

7.3.8 Streamlining the use of NFI data for forest management and investment plans

Q. You suggested many things. It would be more target oriented. You said, NFI Data is important for investment planning. But what do you mean? How can you specify investment plan? But for what purposes?

Ans: The suggestion is very generic. We are just showing how NFI can help in investment plan. NFI can show these are the possible investment areas. We were discussing based on NFI plans. In one of the countries, using NFI, degraded forest areas were identified, and investors came and invested for afforestation plans.

Q. Consistent and robust plot design. What do you mean is it over time, over space?

Ans: On the consistent and robust plot design. It is most likely over time. The plot design should be need-based. We are also talking technology. To make the data comparable, consistent and robust plan design is necessary. The technology should not be outdated.

7.3.9 Integrating remote sensing with NFI data for meeting (sub-) national goals, plans, strategies, etc

Comment: Regional workshops are run because many countries are facing the same problems. We find that knowledge sharing is facilitated in these workshops. But how can knowledge that is being shared here be disseminated better, we need to think about that. We need to come up with a framework to ensure knowledge shared in these workshops are shared better regionally.

Comment: Think about specific activities, research work or more publication work can be done. Think about how you all can collaborate. In most of the presentations—we have heard about Data Sharing. We could talk about why it is important to share data; can we do a better job in communicating data? Why is it important to institutionalize data? These are possible research points. We could also look at ways to integrate NFI data and Socio-economic data.

Matieu said to Group B that, you talk about data sharing and licensing. Use of remote-sensing can reduce costs of NFI. When we procure satellite images, we can request for sharing the satellite images. So that there is data sharing. When we procure satellite images, it is not restricted to one user. Requesting the data to be shared by multiple national entities makes it cost effective. Because satellite images are expensive, and if it is ensured that while we procure satellite images, it is shared by multiple national entities, it becomes cost-effective. Ensure that when you procure satellite images, there is more than one beneficiary.

SESSION 3: Institutionalization/ Sustainability of Forest Monitoring

7.3.10 Questions and answers from session speakers

Comment: Whether the maps are comparable or not. The 2000 map was created after the 2015 map. So, once we had prepared the 2015 map, we overlaid this map on the image of 2000. Based on the Landsat images, these polygons were updated. In 2015 we have more precise information on land cover maps. We did the harmonization of the classes. These two maps are manual.

Comment: We have not used NFI data, because the two processes were parallel. When we started developing the land cover map, we also started collecting NFI data. We did the field verification also. We identified the inconsistent data. Then the Forest Department officials went to verify the inconsistent data. We later aggregated that with our map.

Comment: To regionally usable data: So, in this workshop, our main agenda was to come up with policy and planning issues. One of the challenges and vision was to come up with a common classification system.

7.3.11 Technology and communications to improve NFI data dissemination

Q: Data sharing policy is a requirement. In our region, most of the countries do not have something like this in our context, what major issues should be included in data sharing policy?

Ans: It is hard to answer something like this. Because each country decides that. The policy should be versatile and so that users have access something easily. The policy will decide whether the data is easily available. Whatever the system, freely available or readily available, data should be quickly disseminated. Policy is emphasized, and institutionalization is emphasized. Policy is first, institutionalization is second.

Q. It is hard to access raw data in developing countries? When the data was available? Is it raw data or interpreted data?

Ans: In terms of people using the data to disagree with government, we have even been taken to court. NFI data was used as basis for both parties to make the case. That is what we want, that scientifically accurate data can make the case. Since we are a federal system, we release our data. Q. Productivity of plantation is gradually decreasing. But we cannot convince anyone to increase rotation period. Can NFI be used to convince policymakers to increase rotation period? Ans: The nutrients in trees. It is often difficult to relate what you have in the tree with what you have in the soil. Yes, you can use allometric equation.

Comment: Sri Lanka, has signed a data sharing agreement by 6 ministries. This mechanism can be used for data sharing easily.

Q. What does it mean by improve the standards?

Ans: Sometimes we use local technology and so on and so collaboration can help in improving standards. Q. When you mean collaboration, do you mean only national and regional?

Ans: Both. He gives examples of implementing LCCS by collaborating with multiple organisations, such as BFD, BUET, FAO.

Q. Both presenters said, there is strong collaboration for sharing of data. Under which mechanism does BFD shares this data.

Ans: MoU, Letter of Agreement or by some official circular or orders.

7.3.12 Justifying long-term support

What do you mean by ownership?

Ans: We thought FD is the owner. But if you engage other groups. Like in NFI work, there is remote sensing, so you could involve other orgs.

Q. In the matter of long-term, I suggest all of you, you may target LDG target year. By 2030, we have to achieve the goals by 2030

Q. In this diagram, for NFI, the international support should come, then it will show. My comment is we need to understand what we need at national level. Then we can seek international support. The pressure, where it comes from? Int'l level.

Ans: you are right. From national level, we need to understand what we need, but to start the work international support is needed and that is how the cycle works.

Q. I want to hear something from Sri Lanka, about institutionalization

Ans: Actually, we started last year. We are planning to do this data sharing. We need int'l support, tech, training for future work.

7.3.13 Improving forest information systems

Q. There was a mention of co-ordination between different stakeholders to be promoted by by international partners? Is it not best that it is done nationally?

Ans: In our country (Bangladesh) there exist some system of sharing data, but this is not working. Basically, we ask the donor agencies, to create pressure.

One other answer: In America they put lobbyist in place to push the matter. That cannot be done in Bangladesh. So, some international pressure can help.

If you want to see some int'l body to lobby, it represents that there is already lack of collaboration, in the government. If you have lack of communication, then how will you implement NFI process, we need to remedy that first and that is how we can work better.

Comment: Institutionalization of NFI should come from Government and from a national level. That is how institutionalization happens.

Comment: Capacity building and technological assistance can come from foreign countries (this applies to this whole region)

7.4   Appendix 4: complete results of group discussions

SESSION 1: NFI implementation

7.4.1   Recommendations for technologies and methods for efficient field data collection (e.g. software tools, tablets, etc)

G-1 A	G-1 B

Recommendations for government and policy makers	To national decision makers (i.e. ministries, head of forestry, policy makers):
- If better tech is used then the data is more accurate which can be presented to intl forums such as UNFCCC and COP. The data is more reliable. Another recommendation: is there should be a web platform so that others can access to the data. **For other national stakeholders: university, NGO etc:** -Encourage use of NFI data across the board so that we can have common baseline. -In parallel to using new tech in NFI, it is important to teach these technologies and methods should be made available -Mmight be useful for local people too. You can also learn what amount of sustainable yield can be done from an area. Eg. so and so amount of **-For international partners (e.g. FAO, USAID, JICA, other donor agencies)** -Why should USAID or other international organizations should deploy new tech? If we can justify what amount of socio-economic benefit, If we can measure it well, we can conserve it will. That can be done through modern tech. If a country is not using modern scientific tech. The reports will not be acceptable internationally.	-Promote the use of new technology and software (etc. open foris,) (with justification in terms of adaptability, efficiency, cost-effectiveness, transparency, proven accuracy) -Facilitate training to improve capacity to use the modern technology -Institutionalize the NFI data collection -Provide incentives to the data collectors -Increase the safety measure and insurance facility -Incorporate socioeconomic data collection to NFI -Include tree outside forest in NFI **To national partners (e.g. universities, other research organizations, government and non-government agencies)** -Promote data sharing -Facilitate research initiatives to identify better methods -Collaborate with NGOs for collecting the social data -Engage universities in the training and capacity building **To international partners (e.g. FAO, USAID, JICA, other donor agencies)** -Training for technology transfer -Provide financial support - Facilitate regional collaboration by exchanging knowledge and technological expertise (e.g. training of trainers) -Harmonize the data collection method across the countries -Standardize the land-plot ratio for sampling (sampling intensity)

7.4.2 *Recommendations for ensuring data integrity (effective training, QA/QC, data cleaning, etc)*

G-2A	G-2B

Proposed recommendations – To National Decision Makers:	Proposed recommendations: To national Decision makers:
-Same equipment should be used throughout the crew team -Single responsibility should be given to quality control team -Institutionalization of QA -QA team should be provided additional incentives and allowances -Quality control team's role should be established -QA team continuously assess the field crew & communicate -Choose Right person in the right place -Simultaneous assessment of the data & Communicate **To national partners (e.g. universities, other research organizations, government and non-government agencies):** -Involvement of the partners -Same equipment/methodology should be used throughout the crew team -Quality control team roles should be established -QA team continuously assess the field crew & communicate -Education and training on QA **To international partners (e.g. FAO, USAID, JICA, other donor agencies):** -Same equipment/methodology should be used throughout the crew team -Quality control team roles should be established -QA team continuously assess the field crew & communicate -Funding for capacity building	-Take inputs form policy makers for team building for conducting QA/QC of the NFI plots through -Timely allocation of funds -Smooth process/approval of the activities Institutionalization of the NFI process **Proposed recommendations: To national partners (e.g. universities, other research organizations, government and non-government agencies):** -Ensure well trained field crews with good field protocol for improved data quality -A good synchronization between protocol, training and technologies to be used in the data organization/management/analysis -Changes in measurement parameters may affect the data analysis procedure, consistency in outputs, comparison of the results with historical data and monitoring changes over time. -To avoid these problems well record of the changes, efficient and quick communication to the field teams about the changes, harmonization of the outputs considering the situation may be adopted. -The field teams should note the changes/deviations in measurement in the data collection/record forms **To international partners (e.g. FAO, USAID, JICA, other donor agencies):** -Institutionalize the quality control activities to make it sustainable. Involve independent bodies for QA/QC. -Capacity building on new technologies -More regional exchange events -International funding for smooth NFI process

7.4.3 Recommendations for strategies to address inaccessible or difficult to access plots

G-3A	G-3B
To national decision makers (i.e. ministries policy makers): -Propose policy that NFI be applied across different lands (PAs, etc.) -Partner with state/contractors -Establish inter-agency or multi-stakeholder collaboration or platform specific to NFI -Establish a policy allowing local community members to participate in the NFI activities train local crew/communities/ but ensure high quality data collection and maintain plot integrity **To national partners (e.g. universities, other research organizations, government and non-government agencies)** -Establish a platform for State Universities/CSOs support the NFI activities with a note that data collection and integrity is assured/make sure government standards is met **To international partners (e.g. FAO, USAID, JICA)** -Encourage the countries to make the best decision, present pros and cons and let the country decide for country ownership and accountability -Encourage donors to support regional learning exchanges -Support NFI activities (e.g. technical inputs, funding, technologies)	**To national decision makers (i.e. ministries, head of forestry, policy makers):** -Create awareness about the importance on international and national reporting -Develop infrastructure, institutional arrangement and capacity building **To national partners (e.g. universities, other research organizations, government and non-government agencies)** -Anticipate in the design phase of the NFI, the problem of large inaccessible areas. Include an component in the design phase that outlines the risk bias and proposes solutions. -Justify additional money needed to address large non-sampled area. Clearly communicate the importance of non-sampled areas to decision makers. Give clear examples of the consequences of missing data related to biodiversity, tree cover, and forest. -Continue research into optimal approaches for addressing large nonsampled areas (e.g. models for model-based estimates; mixed approached; hybrid approaches; new spaceborne lidar/radar) -Consider how to better harmonize approaches across borders. **To international partners (e.g. FAO, USAID, JICA, other donor agencies)** -Develop a guideline for addressing large non sampled areas -TCP or other funding for workshop to support the development of general guidelines -Develop country or region specific guidelines that include piloting studies

7.4.4 Recommendations for streamlining the use of NFI data for national, sub-national, and international reporting purposes

Group 1 A	Group 1B
To national decision makers (i.e. ministries, head of forestry, policy makers): -Policy on data and information sharing , -Dissemination mechanism -Capacity building to draft report and analyze data, etc. (individual and institutional) -Institutionalization of NFI reporting -Strengthening of linkage among stakeholders -Use of NFI data and information in planning purposes **To national partners (e.g. universities, other research organizations, government and non-government agencies)** - Partners involvement are recommended to do the QC/QA process, to ensure transparency -Dissemination of reports and during drafting of NFI report sharing with partners are encouraged -Research institutes are recommended to include NFI topics in their curriculum or research (research and teaching) -Stakeholder engagement through coordination/collaboration **To international partners (e.g. FAO, USAID, JICA, other donor agencies)** -Support and assist in capacity building (e.g. technical expertise, technology, funding, expert exchanges/training) -Knowledge sharing / establish international network/forum -Joint resource mobilization / partnership to access funding (e.g. FCPF, GCF, etc.) -Standard reporting templates	**To national decision makers (i.e. ministries, head of forestry, policy makers):** -Policy to use NFI (data sharing) Publicity (media) -Accessibility (web site to share data, good -Archiving system, one team responsible for data providing for special requests) -Documentation of data collection, analysis, quality control (and of the changes in methodology over time) engagement with differ stakeholders at the beginning of the process to ensure the consistency of report, definitions -Recognition of NFI as national experts on forest issue Consistency in decision making **To national partners (e.g. universities, other research organizations, government and non-government agencies):** - Promoting scientific publications using NF data with correct reference - Involvement of national partners during the initial stage - Recognition of NFI as national experts on forest issue - Provide feedback using the NFI data for improvement **To international partners (e.g. FAO, USAID, JICA, other donor agencies):** - Recognition of the NFI effort (references to NFI work) - Promote using NFI data (IPCC) in global dataset, with correct citation - Transparency in their own methodology - Provide clear guidelines for reporting

7.4.5 Recommendations for use of NFI data for forest management and investment plans

Group 2A	Group 2B
To national decision makers (i.e. ministries, head of forestry, policy makers): - Policy formulation and Forest management plan development. - NFI report sharing to policy makers for Protected area identification, delineation of production forest, Country investment plan, New processing plans -International commitment **To national partners (e.g. universities, other research organizations, government and non-government agencies)** -Capacity building for management purposes -National and international reporting -Creation of common platform -Workshop arrangement -Multi-use of data, Need based research **To international partners (e.g. FAO, USAID, JICA, other donor agencies):** -Workshop arrangement -Regular training for capacity buiding -Providing resources and technologies for developing countries -Financial support	**To national decision makers (i.e. ministries, head of forestry, policy makers):** -Planning and policy formulation -Data sharing -Institutionalization of NFI **To national partners (e.g. universities, other research organizations, government and non-government agencies)** -Coordination -Data sharing -Research for change assessment (Indicator identification, scope) -Capacity building -Institutionalization of NFI **To international partners (e.g. FAO, USAID, JICA, other donor agencies)** -Capacity building -Funding

7.4.6 Recommendations for integrating remote sensing with NFI data for meeting (sub-) national goals, plans, strategies, etc

Group 3A	Group 3B

To national decision makers (i.e. ministries, head of forestry, policy makers): -To share data amongst intra ministerial, agency provide the security and author is acknowledged -Less bureaucratic, minimum charge **To national partners (e.g. universities, other research organizations, government and non-government agencies):** -More Collaboration – update on technology -Continue capacity building **To international partners (e.g. FAO, USAID, JICA, other donor agencies):** -More Collaboration with countries -Facilitating sharing of data in the country -Facilitate Regional/international knowledge sharing	**To national decision makers (i.e. ministries, head of forestry, policy makers):** -Understand how to use maps and the limitations of remote sensing data (i.e. don't assume that remote sensing solves all the problems) -Develop data sharing policies that allow sharing data, tools and scripts for integrating remote sensing and NFI data with neighboring countries and international partners. -Budget for VHSR, Higher temporal frequencies -**To national Partner (e.g. universities, other research organizations, and government and non-government agencies)** -Provide accuracy assessments (map validation) of products to national decision makers. -Propose more research calls for developing techniques that integrate remote sensing and NFI data. Do more independent research in this area (e.g. techniques for using VHSR, mapping forest attributes) -Participate in capacity building trainings for Mapping skills -Support better coordination with other agencies **To international partners (e.g. FAO, USAID, JICA, other donor agencies)** -Sharing costs with country partners. For example, purchasing of high resolution data and wall to wall coverage if possible -Training and capacity Building. -Develop tools that are better and easier to use the forest managers (not programmers) that integrates both remote sensing and field data. -Develop online library of scripts, tools and methods for integrating remotes sensing and field data used by other countries

SESSION 3: Institutionalization/ Sustainability of Forest Monitoring

7.4.7   Recommendations for strengthening institutional arrangements

1 A	1B
To national decision makers (i.e. ministries, head of forestry, policy makers): -Formulate national policy -Establish NFI unit -Regular budget allocation from the government -Form a panel from different agencies **To national partners (e.g. universities, other research organizations, government and non-government agencies):** Regular update of NFI technologies and methods in academic curriculum -Give access to NFI data to universities, other research organizations, government and non-government agencies -NGOs, universities should use NFI data (in planning, implementing, research activities, etc.) **To international partners (e.g. FAO, USAID, JICA, other donor agencies):** -Help assist in data sharing platform -Assist in capacity building on how to use NFI data -Continue support	**To national decision makers (i.e. ministries, head of forestry, policy makers):** 1. To formulate win-win collaborative arrangements with various agencies 2. To establish a recruitment process to hire qualified, permanent NFI staff / provision of continuous trainings To allocate sufficient funds for the NFI activities / identify co-funding opportunities understand the importance of using NFI data for management and policy making and national planning Adopt new technologies / equipment **To national partners (e.g. universities, other research organizations, government and non-government agencies)** 1. Share and collaborate well / active participation according to agreed roles and responsibilities 2. Focus on the public good (positive well-being) and not on defending "turf" 3. Establish a network of universities/NGOs/CSOs aimed to support and enhance NFI (e.g. research to improve the NFI, extend the use, improve the standards, support information dissemination, etc.) **To international partners (e.g. FAO, USAID, JICA, other donor agencies)** 1. Funding support, technical expertise, capacity building 2. Assist in institutionalizing the NFI 3. foster regional collaboration and exchanges (e.g. data sharing, address common problems)

7.4.8 Recommendations for justifying long-term support

Group:2
To national decision makers (i.e. ministries, head of forestry, policy makers): 1. Establishment of legal basis for NFI by forest law 2. Establishment of dedicated NFI unit 3. Adequate and continuous budget allocation from national budget for NFI 4. Fund raising for NFI from forestry activities 5. Dedicated IT support to NFI **To national partners (e.g. universities, other research organizations, government and non-government agencies):** 1. Maximize the use of NFI data 2. Continue stakeholder engagement in NFI process 3. Ownership (engage universities and research institutions) 4. Easy accessibility to NFI data **To international partners (e.g. FAO, USAID, JICA, other donor agencies):** 1. Provide technical support 2. Provide training and capacity building

7.4.9 Recommendations for improving forest information systems

3A	3B
To national decision makers (i.e. ministries, head of forestry, policy makers): -Inter-ministerial meetings regarding the topics -Recommend the NFI data to be official data and department to use the data -Decision is needed for publication of the QAQC report on result/oversees stakeholders to publish in a web-based platform **To national partners (e.g. universities, other research organizations, government and non-government agencies):** -Data sharing agreement -Acknowledgement (citation) and submit copy of the paper to the concerned authority	**To national decision makers (i.e. ministries, head of forestry, policy makers):** -Define data and clarify objective of the use of data -Clear legal framework and mandate -Creation of Data sharing portal -**To national partners (e.g. universities, other research organizations, government and non-government agencies)** -Define data and clarify objective of the use of data -Efficient data sharing platform and tools -Support awareness building -MoU amongst the stakeholders -Institute a feedback mechanism/exchange opnions between data producer and user

To international partners (e.g. FAO, USAID, JICA, other donor agencies)	To international partners (e.g. FAO, USAID, JICA, other donor agencies)
-Acknowledgement (citation) and submit copy of the paper to the concerned authority -Facilitation of regional gaps and errors at regional or international workshop, capacity building on advance technology transfer -Funding for NFI implementation Advocacy in favour of country/access to trade -Certification of land cover map (e.g., LCCS is the ISO standard)	-Capacity building -Funding -Encourage coordination among stakeholders

7.5 Appendix 5: list of relevant documents shared to participants

Title	Country
1. Semi-destructive Method for the Development of Biomass Allometric Equation in Bangladesh (Poster)	FAO,Bangladesh
2. Strategies and technologies used for establishing and relocating permanent forest inventory plots in Bangladesh (Poster)	FAO,Bangladesh
3. Land Feature Data Collection- Integration of Remote Sensing With Field Data Using Object Based LCML/LCCS Approach (Poster)	FAO,Bangladesh
4. Legend for National Land Cover Map 2015 (Poster)	FAO,Bangladesh
5. Bangladesh Forest Inventory- Plot Attributes Measurements (Poster)	FAO,Bangladesh
6. Socioeconomic Survey of Bangladesh Forest Inventory (BFI) (Poster)	FAO,Bangladesh
7. National Land Representation System- Schematic Overview of the Basic Classes Relationship. (Poster)	FAO,Bangladesh
8. Manual For Building Tree Volume And Biomass Allometric Equation For Bangladesh	FAO,Bangladesh
9. Training materials for the biophysical component survey of the Bangladesh Forest Inventory – concepts, planning and procedures (Manual)	FAO,Bangladesh
10. Field Instructions for BFI Socioeconomic survey (Manual)	FAO,Bangladesh
11. Field Instructions for BFI (Manual)	FAO,Bangladesh
12. Manual for Forest Land Boundary Digitization	FAO,Bangladesh
13. Training Manual Sample Processing and Laboratory Analysis for the Development of Allometric Equation	FAO,Bangladesh
14. Manual For Soil Measurements For The Bangladesh Forest Inventory	FAO,Bangladesh
15. National Land Representation System of Bangladesh	FAO,Bangladesh
16. Quality Assurance and Quality Control for the Bangladesh Forest Inventory	FAO,Bangladesh
17. Quality Assurance and Quality Control for the Socio-economic Component of the Bangladesh Forest Inventory	FAO,Bangladesh
18. Monitoring of Changes in Woodlots Outside Forests by Multi-temporal Landsat imagery (Research Article)	Bangladesh

19.	Monitoring Mangrove Plantation along the Coastal Belts of Bangladesh (1989-2010)(Regular Article)	Bangladesh
20.	Field Manual National Forest Inventory of Bhutan	Bhutan
21.	National Forest Inventory Report Stocktaking Nation's Forest Resources Volume 1	Bhutan
22.	Forest Inventory of India News Letter Volume 1, Issue 4	India
23.	Manual for NFI	India
24.	NFI in Lao PDR	Lao PDR
25.	Lessons From Early REDD+ Experiences in the Philippines (Review Article)	Philippines
26.	Unbiased Emission Factor Estimators For Large-area Forest Inventories: Domain Assessment Techniques (Publication)	FAO
27.	Land Cover Classification System- Classification concepts, Software version 3 (Manual)	FAO
28.	Manual for Building Tree Volume and Biomass Allometric Equations	Bangladesh
29.	Summary of The Manual for Building Tree Volume and Biomass Allometric Equations: From Field Measurement To Prediction	FAO
30.	Voluntary Guidelines on National Forest Inventory	FAO
31.	Mangrove Carbon Estimator and Monitoring guide	FAO
32.	Forest Inventory and Analysis National Data Quality Assessment Report for 2000 to 2003	USDA
33.	The Enhanced Forest Inventory and Analysis Program—National Sampling Design and Estimation Procedures	USDA

7.6   Appendix 6: case studies

7.6.1   The case of Indonesia's NFI

The objectives of Indonesia's NFI includes Forest Resource Assessment, Forest Resource Monitoring and Biodiversity Monitoring. Major uses of NFM and NFI data include national reporting, international reporting, research, planning, management and conservation. Some of the challenges of Indonesia's NFI includes, high percentage of inaccessible or difficult to access plots, many local names of trees are unknown botanical names and the high cost of field surveys. In Indonesia, Forest management plan is not only institutionalized, it is constitutionalized. In the Indonesian NFI, soci-economic data is not integrated. It is mostly limited to Biophysical data now. There is mandate to develop national forestry mandate and says that in Indonesia they update it every year. NFI supports REDD+ mechanism and Forest Reference Emission Level activities in their country. NFI supports their forest management planning. Forestry enterprise: is a private company-- maybe from outside or so on. Some companies are trying to restore forest data. In FMU and Forestry enterprise, it is mainly for forest area and land cover map. Limitations of NFI are that they lack of information on biodiversity and there is a technical problem as well. An example of that is in Indonesia botanists are not very abundant and it is difficult to identify species. NFI provides necessary data for supporting forest-related policies (e.g. GHG emission reduction) in Indonesia. NFI data are used at various levels of forest management planning in Indonesia and the existing NFI system of Indonesia needs continuous improvements to generate more comprehensive data and information.

7.6.2   The case of Viet Nam's NFI

The objectives of the Viet Nam NFI include estimation of Forest Area and volume, to make plans targeting barren land for forests and to make forest management documents. The major uses of NFM and NFI data in Viet Nam is for reporting, research, investment, planning, management and conservation. Government agencies involved in Viet Nam are the Ministry of Agriculture and Rural Development. Viet Nam has used NFI for FREL/FRL development. The NFI in Viet Nam has been named as "National Forest Inventory, Monitoring and Assessment Programme" (NFIMAP) and has been implemented since 1990 in 5-year cycles by FIPI. So far four cycles have been completed and working is going on on Cycle V which will be completed in 2020. There were two main components of the Viet Nam NFI - forest cover maps generation and Forest inventory. Forest Reference Emission Level (FREL) and Forest Reference Level (FRL) are benchmarks for assessing the performance of REDD+. FREL: includes deforestation & forest degradation and FRL: includes reforestation & forest restoration (i.e. enhancement of C stock). For further improving NFI for FREL, the presenter suggested to develop forest cover maps based on previous maps to increase consistency and reduce artifact changes and to generate time-series information on forest and land use transitions. Some of the major challenges identified by Viet Nam include technology, sources to gather satellite images and lack of funding for NFI.

7.7 Appendix 7: Pictures

Figure 1 Durgesh Kumar Nagar of Forest Survey of India, explains to his colleagues about NFI experiences in India

Figure 2 Gael Sola of FAO presents results from a questionnaire for comparing NFI among countries in South and Southeast Asia

Figure 3 Tatang Tiryana of Bogor Agricultural University in Indonesia, Adam Gerrand of FAO, Chip Scott formerly of USFS, and Lobzang Dorji of Forest Resources Management Division in Bhutan engage in discussion about an NFI topic.

Figure 4 Workshop participants discuss key issues make recommendations. Over 15 working groups were formed to discuss nine different NFI topics in the workshop.

Figure 5 Dr. Mariam Akhter of Bangladesh Forest Department presents to colleagues about the challenges and highlights of the Bangladesh Forest Inventory.

Figure 6 Luca Birigazzi of FAO, Nguyen Dinh Hung of Forest Inventory and Planning Institute in Viet Nam, and Tatang Tiryana of Bogor Agricultural University in Indonesia answer questions after giving their presentations about the use of NFI for national plans and monitoring.

Figure 7 Experts from the Bangladesh Forest Inventory give a field demonstration about the use of DGPS and RFID technology for relocating forest plots.

Figure 8. Mondal Falgoonee Kumar of Bangladesh Forest Inventory demonstrates in the field the use of innovative technology for forest mensuration.

Figure 9 From left to right, Mariam Akhter of Bangladesh Forest Department, Rosaizan Haryani Binti Rosli of Forestry Department Peninsular Malaysia, Kinley Dem Forest Resources Management Division in Bhutan, Taya Levine of TRG, Nurhayati of Directorate of Forest Resources, Nandini Sarker of Bangladesh Forest Inventory, Abida R Chowdhury, and Heather Hunsaker of USFS.

Figure 10 Rosaizan Haryani Binti Rosli of Forestry Department Peninsular Malaysia and Adam Gerrand of FAO give a summary of workshop outputs and discuss future action points.

Figure 11 Participants pose for a photo during a hike in the Lawarchara National Park.

Figure 12 Participants from 14 countries gather for a photo at the conclusion of the workshop.