



## Multipurpose Inventory as part of the National MRV for Greenhouse Gas Reporting: Assessment of Emission Factors



## REDD + Activities and Requirements

- **Levels - Tiers**

- **Tier 1** methods are designed to be the simplest to use, for which equations and default parameters values (e.g. emission and stock change factors are provided in IPCC guidelines. Country specific activity data are needed, but for Tier 1 there are often globally available sources of activity data estimates, although these data are usually spatially coarse.
- **Tier 2** can use the same methodological approach as Tier 1 applies emission and stock change factors that are based on country or region specific data, for the most important land-use or live stock categories. Country defined emission factors are more appropriate for the climatic regions, land-use systems in that country. Higher temporal and spatial resolution and more disaggregated activity data are typically used in Tier 2 to correspond with country defined coefficients for specific regions and specialized land-use or live stock categories.
- **Tier 3**, higher order methods are used, including models and inventory measurement systems tailored to address national circumstances, repeated over time, driven by high resolution activity data and disaggregated at sub national-level. These higher order methods provide estimates of greater certainty than lower tiers. Such systems may include comprehensive field sampling repeated at regular time intervals and/or GIS-based systems of age, class/production data, soils data and land-use and management activity data, integrating several types of monitoring. Pieces of land where land-use change occurs can usually be tracked over time, at least statistically. In most cases these systems have a climate dependency, and thus provide source estimates with inter-annual variability. Detailed disaggregation of livestock population according to animal type, age, body weight etc. can be used. Models should undergo quality checks, audits and validations and be thoroughly documented.



## **REDD + Activities and Requirements**

### **Expert meeting on assessment of forest inventory approaches for REDD+ 1 June 2011 Requirements for Forest Inventory defined as follows:**

- **Inventory must reflect institutional capacity**
  - Create a vision and establish objectives for a long-term inventory
  - Create a permanent institutional setting for a long-term inventory requires
  - Build in-country forest inventory capacity and infrastructure
- **Inventory must satisfy information needs**
  - National and local level forestry and land use planning needs, and therefore the inventory should cover all land classes
  - International monitoring and reporting needs including REDD+ MRV, both strategic and operational needs as much as possible
  - Varying spatial and temporal resolution needs
  - Accuracy requirements have to be determined for the most relevant attributes to be assessed when designing the inventory



## **REDD + Activities and Requirements**

### **Expert meeting on assessment of forest inventory approaches for REDD+ 1 June 2011 Requirements for Forest Inventory defined as follows:**

- **Inventory should exploit remote sensing (RS) data as auxiliary to field data.**
- **Design should be pre-evaluated by experts, including forest statisticians, to assure that it is feasible and will yield credible results.**
- **Analysis should consider how to produce annual estimates of C and  $\Delta C$ , possibly as early as the first year following implementation.**
- **Inventory should be able to assess biomass  $\Delta C$  from fellings.**
- **Inventory must be designed to achieve the desired allowable error estimates for the current state and change estimates, including change estimates for each carbon pool (aboveground biomass, belowground biomass, litter, soil, deadwood) at the national level.**
- **Analysis must permit statistically defensible assessment of uncertainty including all sources of variability, see section Recommendations (details follow).**
- **Inventory must permit assessment of quality assurance and control (verification).**



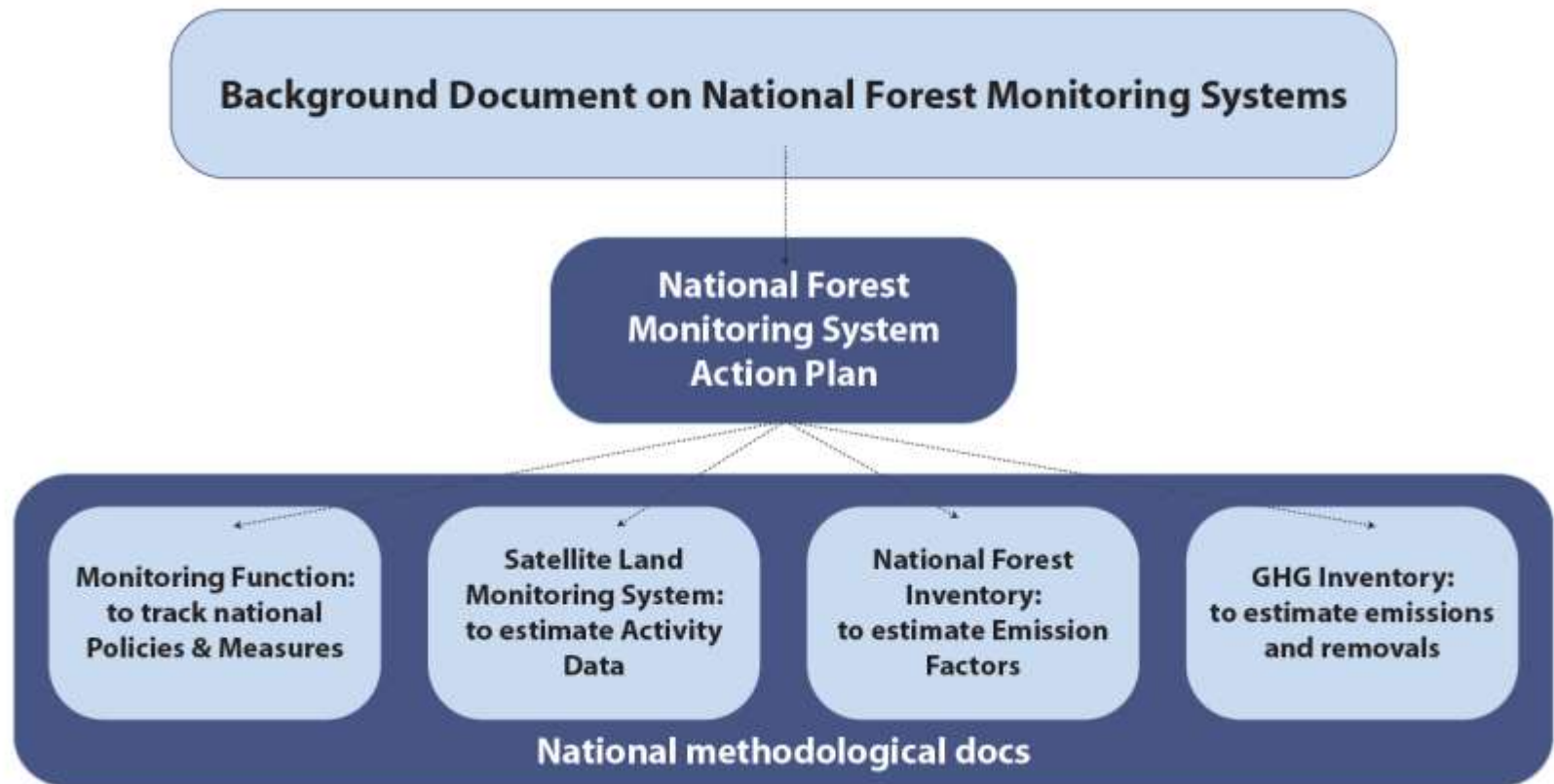
## **REDD + Activities and Requirements**

### **Expert meeting on assessment of forest inventory approaches for REDD+ 1 June 2011 MRV Recommendations**

- **Design should target repeated inventories, e.g., including permanent field plots from the start.**
- **Design should encompass a systematic layout of plot clusters (aligned or unaligned).**
- **Stratification is recommended to increase the efficiency of an inventory and to capture the estimates for the rare events. Two options for stratification are suggested, notably:**
  - **uniform systematic grid across the landscape followed by post-stratification, or**
  - **pre-stratification with varying systematic intensity**
- **There are trade-offs between these two options. Both pre- and post-strata boundaries will change over time. The statistical implications for analysis and inference differ between the two approaches, and at the planning stage it is crucial that these implications be understood so that inventory objectives with respect to  $\Delta C$  can be satisfied.**
- **The criteria that may be used for stratification (examples: accessibility; biogeographic region; landscape variability, etc.) will vary in importance by country and therefore it is expected that the selection of criteria will also vary by country.**



## REDD + Activities and Requirements MRV System for REDD+?





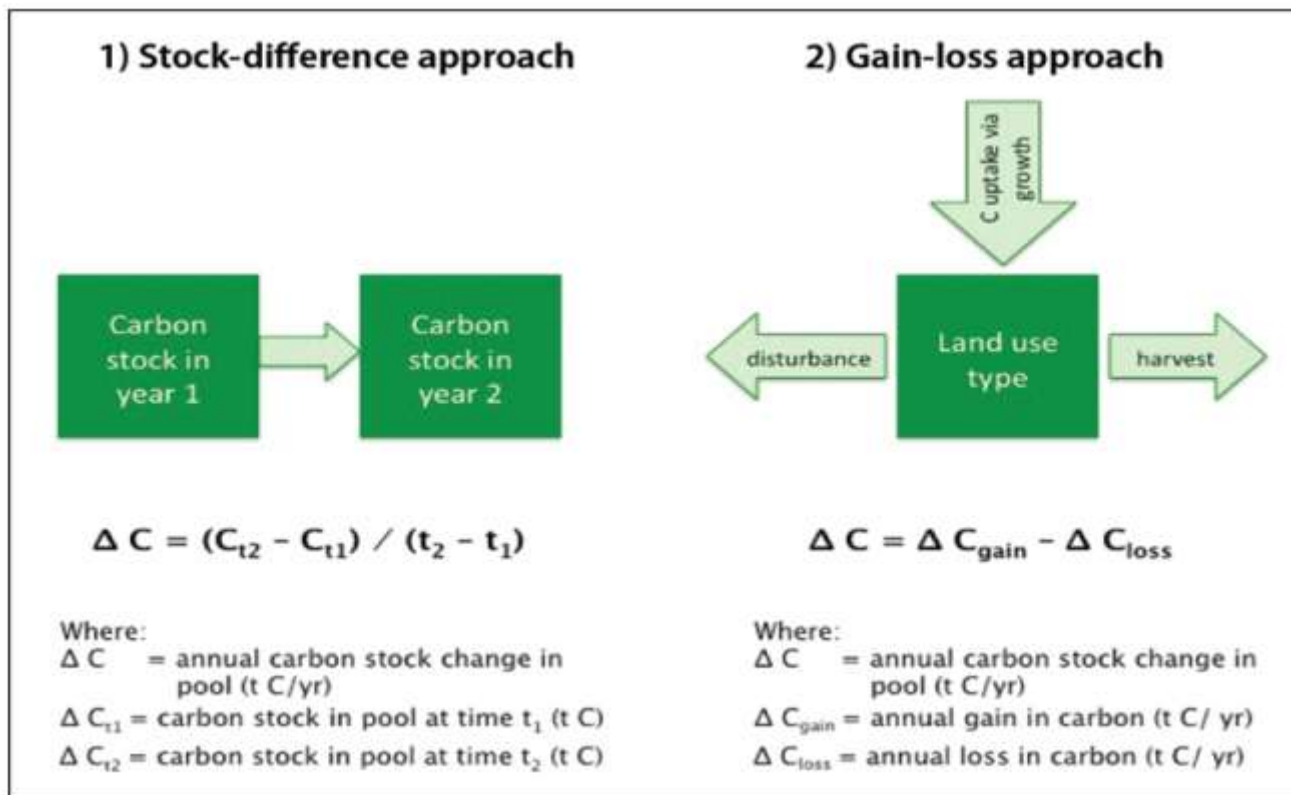
## **REDD + Activities and Requirements** **NFMS - National Forest Monitoring System**

- **Recommendations for National Forest Inventory implementation**
  - Determine if the NFI is a 'pillar' that it would like to use and develop;
  - Define the approach to develop the NFI;
  - Establish a clear and realistic roadmap including the steps to be taken;
  - Build up the required technology and capacities needed;
  - The national forest inventory should be designed to include the collection of the necessary data to assess forest carbon stock and stock changes but also additional multipurpose data that could be used to guide policies and measure;
  - Design a national forest inventory to be sustainably implemented overtime (including for sampling design and biomass estimations).



## REDD + Activities and Requirements NFMS - National Forest Monitoring System

- Alternative to forest inventory which is leading to Stock Difference Approach a **Gain Loss Approach** could be used
- Requirement of Gain-Loss is information on growth rates, harvest amounts and losses to disturbances



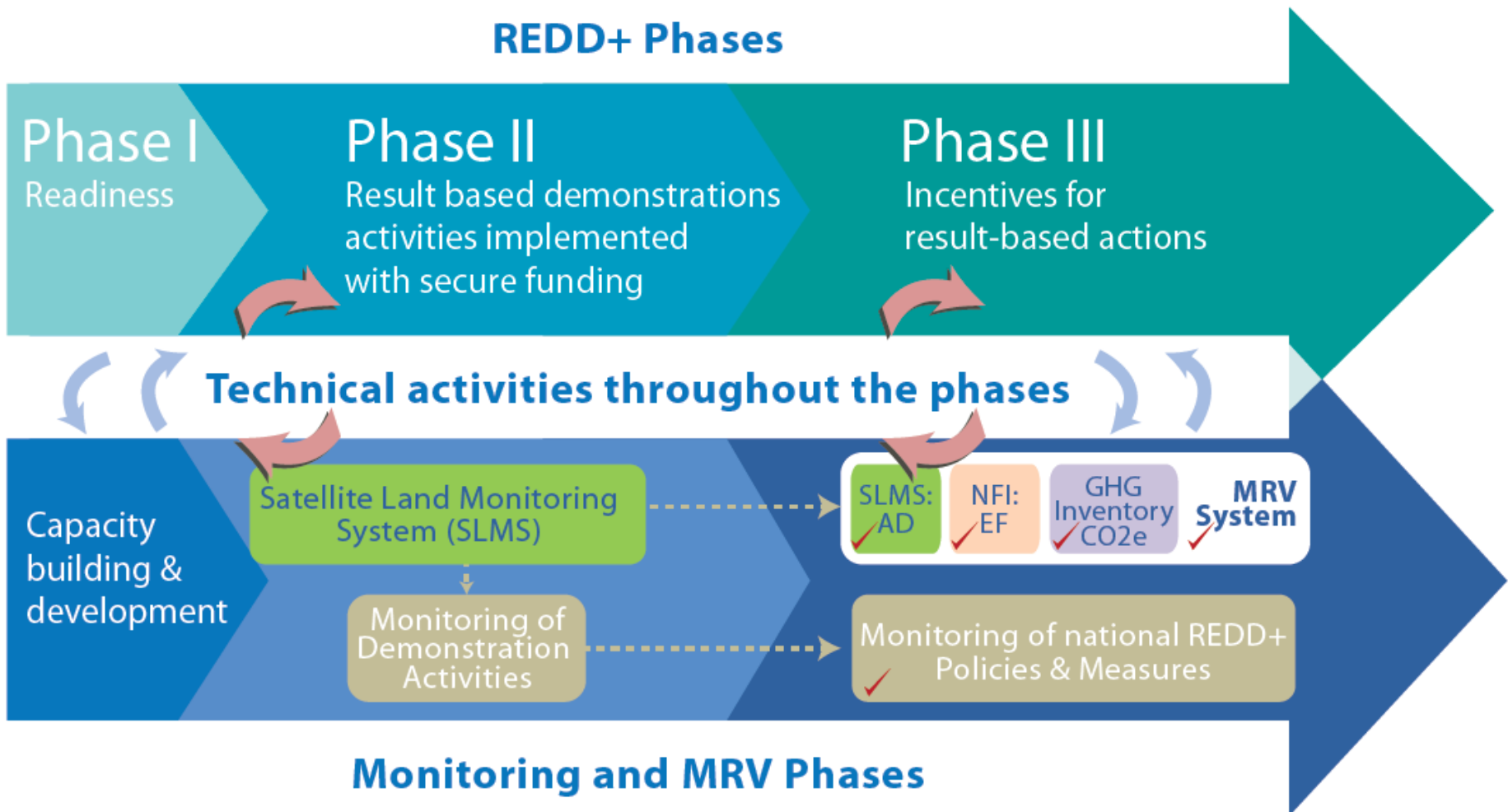




## REDD + Activities and Requirements

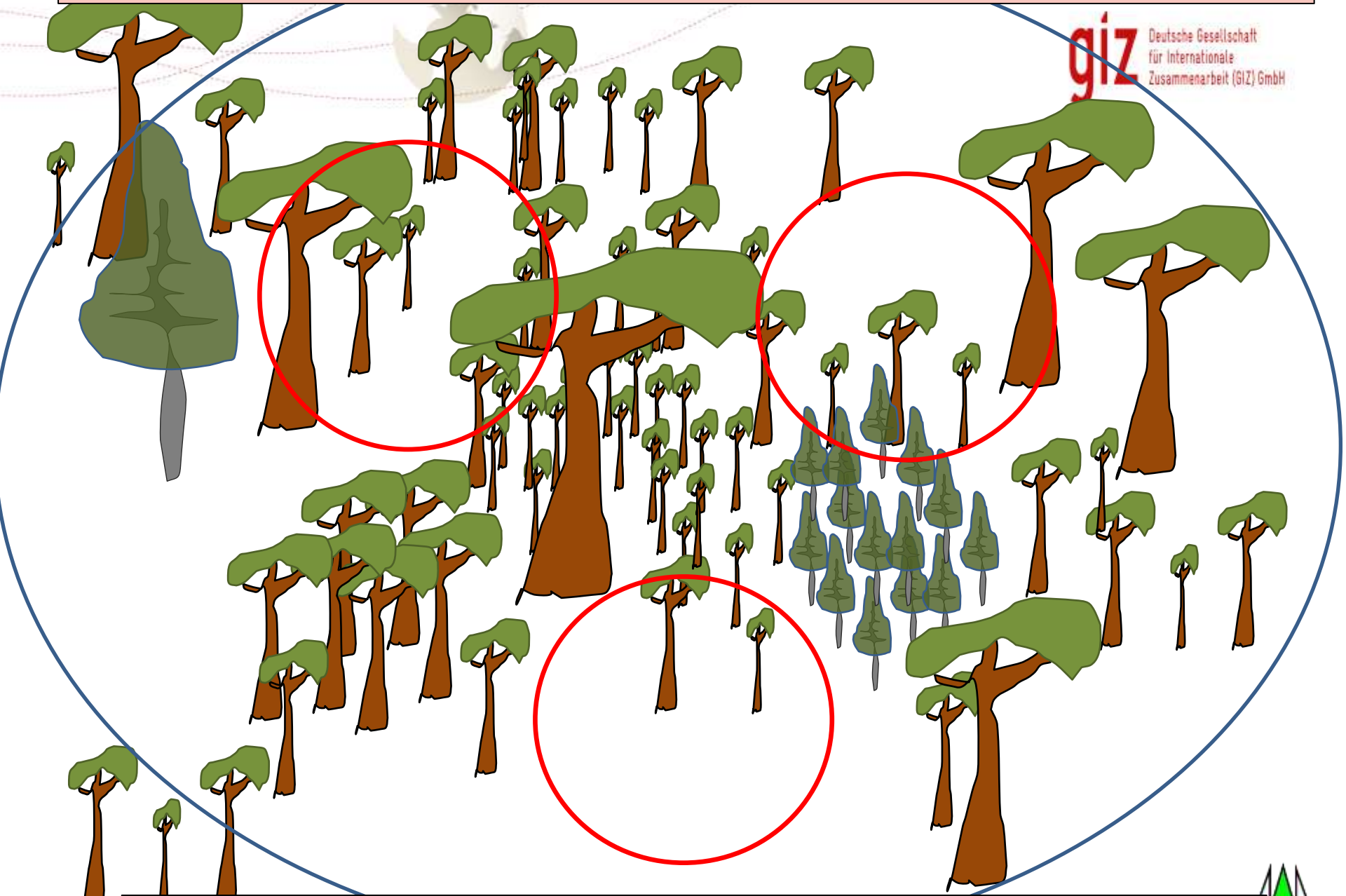
### REDD + Phases for Participants (Developing Countries participating in REDD+)

#### REDD+ Phases



***Statistic Sampling in Forest Inventory looks  
at a picture of the forest at one time***

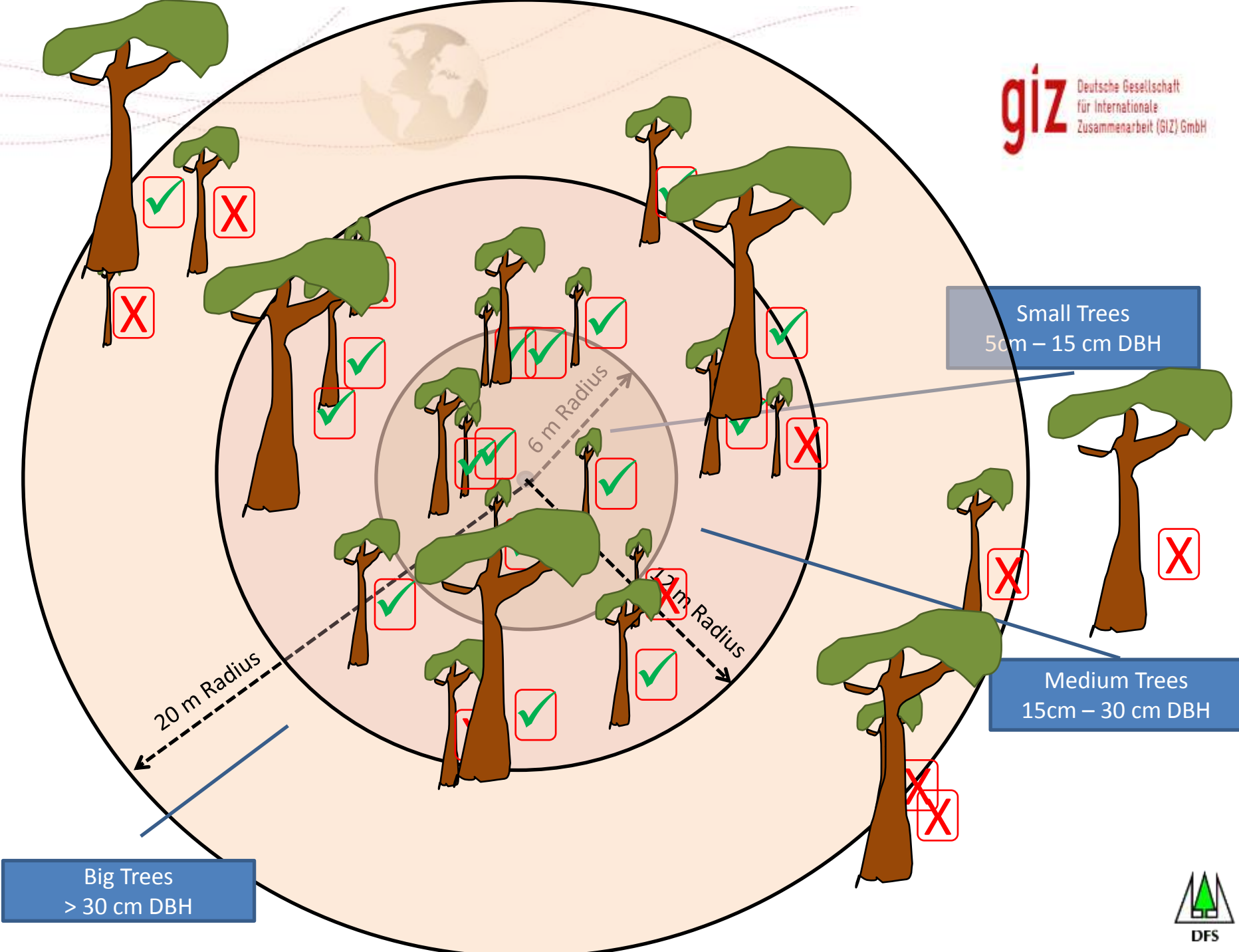
***Solution is several smaller images and averaging to describe the bigger picture***



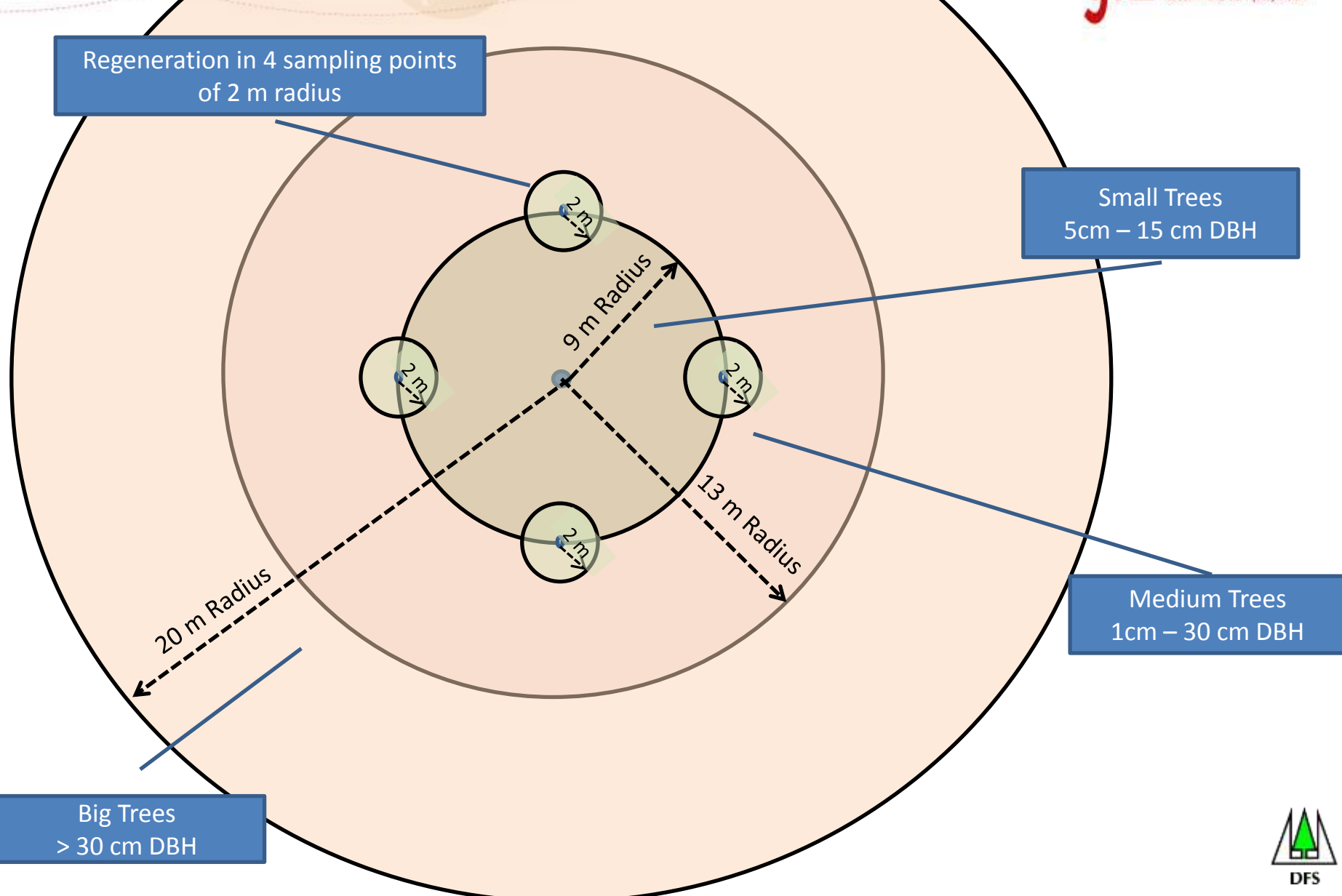
**giz** Deutsche Gesellschaft  
für Internationale  
Zusammenarbeit (GIZ) GmbH

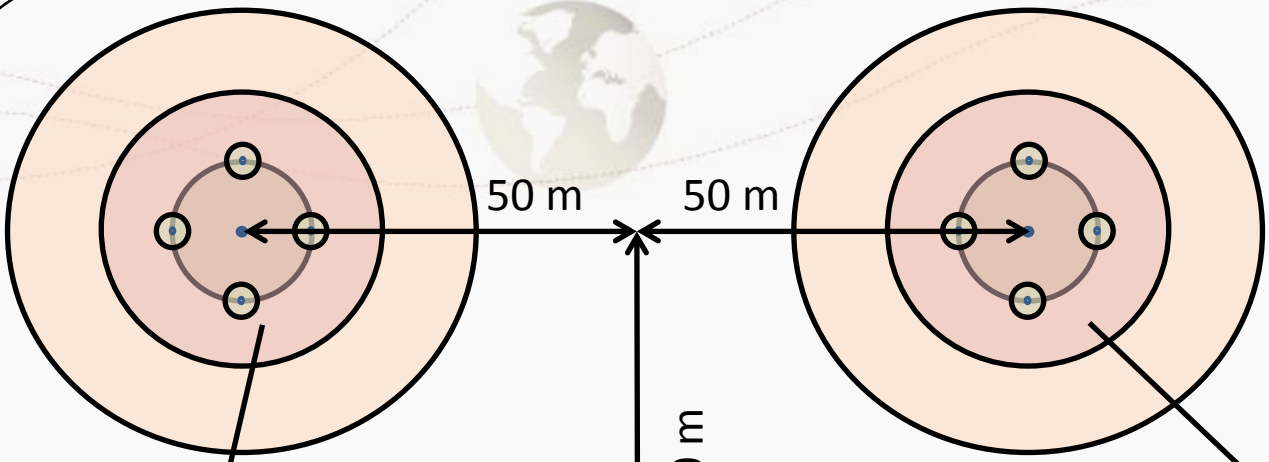
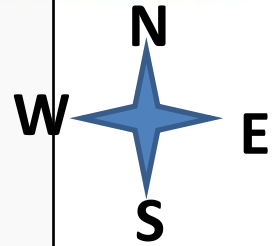
***A big scale image at a time will be laborious big area and many trees***





# Final Design Suggestion: Nested Sampling Circles 2m ; 9m ; 13m and 20m





**Sampling Plot No (3)**

**Sampling Plot No (2)**

**Sampling Plot No (1)**

Center and Starting Point  
of the Sampling Point

**Sampling Unit (cluster of sampling points)**



## Tree and other Data to be collected

### ➤ Tree Data

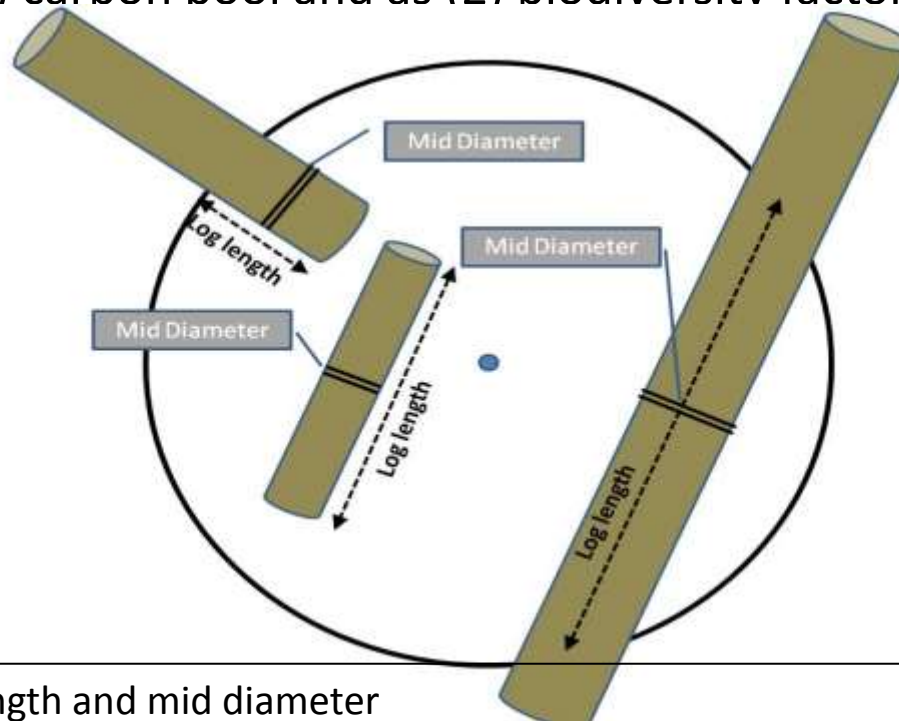
- Species
- Diameter at breast height – all trees
- Total height – for 2 trees per species occurring in a plot
- Damage at the tree – in classes => crown damage, bark damage, insect damage
- Health in classes to include standing dead, decay percentage for dead trees
- Quality – in classes => to be developed and agreed, following existing
- Regeneration damage => browsing animal damage, insect damage



# Dead Wood



- Dead on the Ground measured in sampling circle
- Standing dead measured along with the live trees – biomass using equation and deduction for losses to decay
- Use of data => (1) carbon pool and as (2) biodiversity factor (dead wood is high value habitat)



Easy measurement – length and mid diameter

Only logs or their parts inside 6 m radius circle

Estimation of volume for parts that cannot be easily measured (bundles of small branches and twigs)

Calculation of volume per log

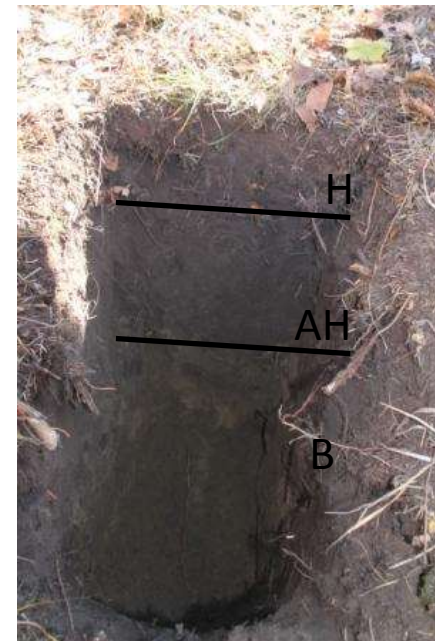
Decay percentage should be recorded to reduce volume / biomass accordingly





## Other Carbon Pools

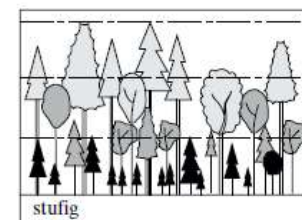
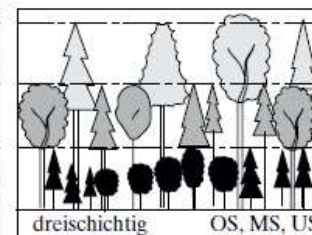
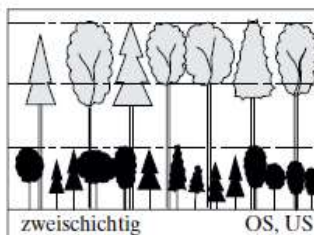
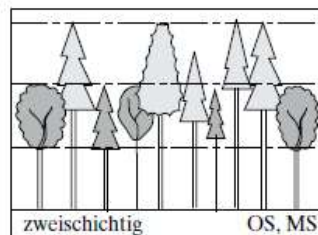
- Litter layer
  - Litter, Humus and Peat layer need to be measured in thickness, organic matter content by using national coefficients
  - ❖ Method to be developed by NUM
  
- Soil Carbon
  - Based on layer thickness and organic matter estimation
    - Measurement of thickness of dark Soil Horizons with soil borer
    - ❖ Coefficient and Method developed by NUM





## Other Observations

- Erosion
  - Occurrence of erosion events, risks of erosion
- Forest Fire
  - Occurrence of forest fire events, intensity of fire
- Grazing inside forest
  - Occurrence of grazing (damage, tracks, droppings), intensity of grazing in classes
- Biodiversity
  - Count of different plant species occurring at the site
- Forest Structure Diversity
  - Occurrence and density of layers assessed





## General Records

- Protection Status at the spot
  - To be take from national maps
- Protection Needs
  - Assessment by the forest experts
- Occurrence of Red List Plant Species
  - Assessment by the forest experts
- Landscape factors
  - Slope, Aspect, Landscape type
  - Assessed by the forest experts
- Administrative Properties
  - To be taken from Map and local Forest Office



**Thank you  
for your attention**

