

STANDARD OPERATING PROCEDURE 1 (SOP1): SAMPLING DESIGN

Version	1.1	Date of Issue	14/06/2021
Purpose	<p>This SOP serves to establish a spatially referenced, probability-based and geographically balanced sampling design for the estimation of areas in land surveys.</p> <p>Notes:</p> <ul style="list-style-type: none"> • Where permanent sample plots are used and already established from previous surveys, this SOP needs not to be used • If stratified sampling is not selected under step 1, the SOP template can be simplified, and this is indicated in the relevant sections 		
Responsibilities	<p>Coordinator responsibilities include:</p> <ul style="list-style-type: none"> • discuss with the expert statistician to identify a statistically valid sampling design. • form and lead an inventory team. • report directly to the director of climate change unit of the forestry commission. • consult and coordinate with the manager of GIS and forest inventory of the resource management support centre to decide on the sampling size and the sampling unit and report the same to the MRV working group. • similarly, consult the leader of the national GHG inventory team. • nominate and collaborate with a statistician <p>Coordinator : ‘Mr Yakubu ’ Forestry Commission P. O. Box MB 434 Accra-Ghana Phone: +233 302 401210 Website: http://www.fcghana.org/</p>		
Prerequisites	<p>If stratified sampling is selected under step 1 below, maps will need to be generated for every monitoring period as a stratification frame.</p>		
Related documents	<p>This SOP shall make reference to sop 2,3 and 4, and standard forms 1-5. It shall also refer to IPCC 2006 guidelines, the GHG inventory report and the biennial GHG inventory report. It shall as well make reference to the FPP 2012 report, 2000 multi-resource report and 2019 and the current landuse / landcover map. It shall make reference to the National definition of forest and the current national forest inventory report. It shall also make reference to all forest reference level report submitted to the UNFCCC</p>		

Procedure	
Step 0: Pilot survey	<p>Step 0a. The Coordinator in coordination with relevant staff from the Forestry Commission determines the need to conduct a pilot survey that will serve to inform the sampling design.</p> <p>Step 0b. The Coordinator follows steps 1 to 4 and SOP 2-4 to implement the pilot survey and documents the lessons learned from the results using form 1.</p>

<p>Step 1: Determining the basic sampling design</p>	<p>Step 1a. The Coordinator in coordination with the Statistician and relevant staff from the Forestry Commission including the GIS and mapping, mensuration and inventory, and plantations units determines the basic sampling design, including the type of sampling (stratified STR, systematic SYS or simple random SRS), type of sample unit (map pixel, points) and the shape and size of the spatial support used for the interpretation including the definition of any sampling sub-units.</p> <p>Step 1b. The Coordinator shall document the justification for the chosen sampling design using form 1. If the selected sampling design is different from previous sampling designs used for the reference period or previous monitoring period, the documentation shall also address how the change in design affects the comparability and accuracy of the results. The justification shall be documented and stored with the climate change unit, RMSC, and ICT of the forestry commission.</p>
<p>Step 2: Determining the stratification</p>	<p>Sub-step 2a. The Coordinator in coordination with the GIS and mapping unit and the inventory and mensuration unit of RMSC determines the stratification to be used based on the classes of interest in the area.</p> <p>Sub-step 2b. The Coordinator shall document the stratification using form 1. At minimum, this shall include: (i) Number of strata (H) and (ii) a description of each stratum indicating the name of the stratum and description or definition.</p> <p>Sub-step 2c. The Coordinator generates the stratification map that partitions the region of interest into discrete, non-overlapping strata while ensuring a geographically balanced representation. For this, the Coordinator shall consider the administrative units that the activity data area is reported by, the stratification used to report emission factors and areas that are most likely to contain changes. An example of stratification is the vegetation zones that the emission factors are reported by and a forest change map.</p> <p>If there is post-stratification, the Coordinator shall document and store the post-stratification criteria in form 1. It shall be stored with the climate change unit, RMSC, and ICT of the forestry commission.</p>
<p>Step 3: Establishing the number of sample units</p>	<p>The coordinator shall involve the GIS and mapping unit and the inventory and mensuration unit of RMSC, the coordinator of the national GHG inventory and the coordinator of the MRV sub working group to calculate the total sample size using an iterative process that to reach an overall sample size that is feasible considering the time and resources available and for each variable of interest or key variable of interest. Where stratified sampling is not selected under step 1 the number of strata is H=1 and the equations simplify accordingly.</p> <p>Sub-step 3a. The coordinator shall involve the GIS and mapping unit and the inventory and mensuration unit of RMSC, the coordinator of the national GHG inventory and the coordinator of the MRV sub working group to estimate the expected area of each stratum from the stratification map. The Coordinator estimates the expected area proportions based on a judgement about likely occurrence of the variables of interest in the area or based on the pilot survey conducted in Step 0.</p> <p>Sub-step 3b. The Statistician in coordination with the coordinator shall involve the GIS and mapping unit and the inventory and mensuration unit of RMSC, the coordinator of the national GHG inventory and the coordinator of the MRV sub working group calculates the total sample size using the following equation. The Coordinator iteratively modifies the expected variables, mainly the allowable margin of error d, to reach an overall sample size that is feasible considering the time and resources available. The Coordinator summarizes this in Form 1 and uses excel and the grid of samples to determine the overall sample size.</p> $n \approx \left(\frac{t_{\alpha,df} \cdot \sum_{h=1}^H \frac{1}{h} W_h \cdot S_h^2}{d} \right)^2$

	<p>Sub-step 3c. The Statistician in coordination with coordinator defines the allocation rules of the sample units to each stratum and summarizes the allocation of the samples in Form 1.</p> <p>Sub-step 3d. The Statistician in collaboration with the Coordinator adjusts the number of sample units in each stratum until reaching satisfactory expected percentage uncertainty for the variable(s) of interest and ensuring a spatially balanced sample, while not unduly increasing the overall amount of sample units.</p> <p>If there is intensification, the Coordinator shall document how the intensified samples relate to the existing sample units, e.g. in systematic design, are the intensified samples aligned with the existing samples. The justification shall be documented and stored in Form 1.</p>
Step 4: Selecting sample units	<p>Sub-step 4a. The Coordinator establishes the spatial locations of sample units using the database of samples for Ghana, which were created using a globally consistent systematic grid of samples. The Coordinator documents the steps taken in Form 1.</p>

Quality management	
QA / QC procedures	<p>The Statistician provides guidance through the sample design to assure the quality of the design and adherence to statistical best practices. An external entity can be involved for quality control of the sampling design.</p> <p>A two-stage approach for the QAQC shall be applied.</p> <ol style="list-style-type: none"> 1. QAQC shall be applied along every stage of the sample based inventory 2. an independent institution shall be responsible for the overall QAQC at the end of the inventory process.

Version Log

Version	Author/s	Material changes from previous version	Release Date
1.1	<ol style="list-style-type: none"> 1. Mr. Yakubu Mohammed 2. Mr. Thomas Gyambrah 3. Mr. Jacob Amoako 4. Mr. Frank Kwadwo Owusu 5. Ms. Tessia Boateng 6. Dr. Marieke Sandker 7. Ms. Yelena Finegold 		14/06/2021

