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| Standard Operating Procedure 1 (Sop1): Sampling Design |
| Version | *Insert version number of the SOP. Use version log at the end of the SOP for version control* | **Date of Issue** | *Insert date on which this version of the SOP was issued* |
| Purpose | This SOP serves to establish a spatially referenced, probability-based and geographically balanced sampling design for the estimation of areas in land surveys.Notes: * Where permanent sample plots are used and already established from previous surveys, this SOP needs not 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
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| Responsibilities | *Clarify the roles and responsibilities as the instruction will refer to these. For example* *‘Coordinator”: the coordinator will be responsible for discussing with the expert statistician the right sampling design,….”* |
| Prerequisites | If stratified sampling is selected under step 1 below, maps will need to be generated for every monitoring period as a stratification frame. |
| Related documents | *Insert references to related documents, including other SOPs, standard forms and other materials that are part of your monitoring system* |

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| Procedure |
| Step 0: Pilot survey | **Step 0a.** The Coordinator in coordination with *if applicable insert other relevant staff involved in the sampling design* determines the need to conduct a pilot survey that will serve to inform the sampling design.**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 *indicate the possible standard form(s) to be used*. *Template 1 can be used as a basis to create a standard form*.  |
| Step 1: Determining the basic sampling design | **Step 1a.** The Coordinator in coordination with *if applicable insert other relevant staff involved in the sampling g design*. 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.**Step 1b.** The Coordinator shall document the justification for the chosen sampling design using form… *indicate the possible standard form(s) to be used*. *Template 1 can be used as a basis to create a standard form*. 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 *indicate the appropriate place for storing the form in accordance with your requirements. .* |
| Step 2: Determining the stratification | *Note: Where stratification is not undertaken, this step is not required.* **Sub-step 2a.** The Coordinator in coordination with *if applicable insert other relevant staff involved* determines the stratification to be used based on the classes of interest in the area. **Sub-step 2b.** The Coordinator shall document the stratification using form *indicate the possible standard form(s) to be used*. *Template 1 can be used as a basis to create a standard form*. 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. **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 *provide the instructions for generating the stratification map. Instructions might point to the use of specific map products to be used including how this should be applied.* If there is post-stratification, the Coordinator shall document and store the post-stratification criteria in *indicate the possible standard forms to be used and the appropriate place for storing the justification in accordance with your requirements.* |
| Step 3: Establishing the number of sample units | The Statistician in coordination with *if applicable insert other relevant staff involved in the sampling design* calculates 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*.* **Sub-step 3a.** The Statistician in coordination with *if applicable insert other relevant staff involved in the sampling design* estimates 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. **Sub-step 3b.** The Statistician in coordination with *if applicable insert other relevant staff involved in the sampling design* estimates the expected standard errors and the expected percentage uncertainties for the allocated number of sample units in each stratum using the following equations:$$S(p\_{h}) = \frac{\sqrt{p\_{h}\*(1-p\_{h})}}{n\_{h}-1}$$$$U\%(p\_{h}) = t\_{a, df} \* \frac{S(p\_{h}) }{p\_{h}}$$$$U\%(p) = \frac{t\_{a, df}}{p} \* \sum\_{h=1}^{H}W\_{h}^{2}\*S^{2}(p\_{h})$$where p is the area proportion to be estimated for the region of interestph is the area proportion to be estimated for stratum hS(ph) is the standard error of the area proportion for stratum hnh is the number of sample units in the stratum hWh is the weight of stratum h – to be estimated as the proportion of the total area in stratum h*U%(ph)* is the percentage uncertainty of the area proportion for stratum h*U%(p)* is the percentage uncertainty of the area proportion to be estimatedta, df is Student’s *t* given confidence level 1-*α* and the degrees of freedom, $df=n\_{h}-H- 1$. Assuming a large n, the , and therefore, at 95% confidence level  and at 90% confidence level . *Specify the confidence level to be used and indicate which software is being used. Equations may be replaced by the steps of the tool or software used (e.g. excel).***Sub-step 3c.** The Coordinator summarizes the expected proportions, standard errors and associated percentage uncertainties in *indicate the possible standard form(s) to be used*. *Template 1 can be used as a basis to create a standard form*.**Sub-step 3d.** The Statistician in coordination with *if applicable insert other relevant staff involved in the sampling design* 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 *indicate the possible standard form(s) to be used*. *Template 1 can be used as a basis to create a standard form*.$n≈\left(\frac{t\_{α,df}^{}⋅\sum\_{h=1}^{H}W\_{h}⋅S\_{h}}{d^{}}\right)^{2}$*Indicate which software is being used. Equation and sub-step3d may be replaced by a description of the steps of the tool or software used (e.g. excel).***Sub-step 3e.** The Statistician in coordination with *if applicable insert other relevant staff involved in the sampling design* defines the allocation rules of the sample units to each stratum *specify if needed* and summarizes it in *indicate the possible standard form(s) to be used*. *Template 1 can be used as a basis to create a standard form*.**Sub-step 3f.** 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. *Indicate also in case more sample units shall be considered in order to address potential non-response.**Iindicate which software is being used. Sub-step 3f may be replaced by a detailed description of the steps of the tool or software used (e.g. excel).*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 *indicate the possible standard forms to be used and the appropriate place for storing the justification in accordance with your requirements. Template 1 can be used to document this.* |
| Step 4: Selecting sample units  | **Sub-step 4a.** The Coordinator establishes the spatial locations of sample units using *insert here what tool is to be used for this and any processes associated with using it (for example how to gain access if an account already exists).* The Coordinator documents the steps taken in *indicate the possible standard form(s) to be used*. *Template 1 can be used as a basis to create a standard form*. |

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| Quality management  |
| QA / QC procedures | *Indicate the QA / QC procedures to be applied.* |

**Version Log**

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| Version | Author/s | Material changes from previous version | Release Date |
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