CLEAN DEVELOPMENT MECHANISM

CDM-EB50-A30-STAN

Standard

Sampling and surveys for CDM project activities and programme of activities

Version 04.0

United Nations
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Climate Change

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1. Introduction

1. This document includes the requirements for sampling and surveys applied to clean development mechanism projects and programme of activities (POA).

2. Scope and applicability

2. This standard is applicable to CDM project participants, Coordinating/Managing Entities (CMEs) of PoAs and DOEs.

3. This document specifies the reliability requirements and describes appropriate sampling methods and what is expected to be provided in a sampling plan. The general requirements shall be applicable to both small-scale and large scale CDM project activities as well as PoAs[1] with any requirements specified in the applicable methodologies having precedence. Sampling-related requirements pertaining to validation and verification are also included. A definition of essential sampling terminology is included below.

4. This document only addresses random errors associated with sampling and does not address systematic (non-random) errors.

3. Definitions

5. The following definitions are applied in this document:

   (a) A *sample* is a subset of a *population*. The population could be, for example, all households included in a CDM project activity; the sample is a subset of these households. A characteristic of the population, such as average number of hours of operating a biogas stove, or proportion of installed refrigerator units still in operation, will be referred to as a *parameter*. The population parameter is unknown unless the whole population is studied, which is often not feasible or possible. A population parameter can, however, be estimated using data collected from a sample. It is therefore important that the sample is *representative* of the population. The correct choice of sample design can help to achieve this;

   (b) The distinction regarding different *types of data (mean vs. proportion)* is important when determining the size of the sample. Mean (average) values are derived from data that are often referred to as *continuous variables*, whilst proportion (or percentage) values are derived from data that are described as *attributes, yes/no data or binary data.* The following examples reflect different types of data when determination of emission reductions achieved by a project activity requires sampling:

      (i) Mean value for a parameter such as the average annual hours of operation of light bulbs used to estimate energy savings or the average methane content in the biogas recovered from biogas digesters. It can also be the efficiency of replaced equipment, to estimate the characteristics of an

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[1] Afforestation/Reforestation (A/R) project activities and A/R PoAs are excluded in the current version.

equipment or a technology or it may be an output/input of an equipment or technology;

(ii) Proportion value such as the percentage of units still in operation included in a replacement programme for estimating the changes of the operating characteristics of a technology or process.

(c) The parameter estimates that are calculated from the sample data should be: (a) *unbiased* and (b) *reliable estimates* of the population parameters since they will be used in the calculations of greenhouse gas emission reductions:

(i) An unbiased estimate is one that does not systematically underestimate or overestimate the parameter value it is representing. Non-sampling errors are a main cause of estimates being biased, but the choice of sampling design can also have a bearing on whether an estimate is biased or unbiased;

(ii) Reliability of a sample-based estimate is typically expressed in terms of the probability that the population parameter value falls within a specified distance from the sample-based estimate. The probability is called the confidence, and the distance is referred to as the precision. Precision can be expressed in absolute units or in relative (percentage) terms, i.e. as a percentage of the anticipated target value. These standards use relative units for a proportion value of parameters as well as for the mean value of parameters used in the calculation. Confidence is the likelihood that the sampling has resulted in the target value within a certain range of values (i.e. precision);

(iii) A high level of confidence is desirable, and levels of 90% and 95% confidence are commonly used. Equally, small margins of error are desirable, and frequently a precision of $\pm$ 10% is used. The required reliability (both precision and confidence) determines the sample size.

6. For mandatory provisions, the term "shall" is used throughout this standard. The term "should" is used for indicating a typical means for meeting a requirement, the term "may" is used to indicate what is permitted.

4. Sampling requirements

7. CDM PDDs or CDM Programme of Activities Design Documents (CDM-PoA-DDs, CDM-CPA[2]-DDs) utilizing sampling for the determination of parameter values for calculating emission reductions shall include a *sampling plan*[3] with a description of the sampling approach, important assumptions, and justification for the selection of the chosen approach.

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[2] CPA means Component Project Activity.

[3] Revision to sampling plan included in registered PDD documents, for example to shift to a single sampling plan across CPAs of a PoA from separate sampling efforts in each CPA, may be proposed following the procedures for 'changes to registered CDM project activity or PoAs' of CDM Project Cycle Procedure.

8.   The purpose of sampling is to obtain: (a) *unbiased* and (b) *reliable estimates*[4] of the mean value of parameters used in the calculations of greenhouse gas emission reductions.[5]

9.   Requirements for sampling are defined either in the applicable CDM methodology or in paragraphs below, with the applicable methodology having precedence.

10.   Where there is no specific guidance in the applicable methodology, project proponents shall use 90/10 confidence/precision as the criteria for reliability of sampling efforts for small-scale project activities and 95/10 for large scale project activities.[6] This reliability specification shall be applied to determine the sampling requirements for each individual parameter value determined through a sampling effort.[7,8]

11.   Precision of 10 per cent i.e. ±10% in this standard shall be interpreted:

(a)   As a *relative* unit *when the parameter of interest is a proportion (or a percentage).* For instance, ±10% in relative units means that the interval around a proportion value of 70% is 63% to 77%. A proportion can describe either of the two possible scenarios of the success rate or the failure rate – for example (i) cook stove still operational or (ii) cook stove no longer operational. Project proponents may use the larger of the two proportions in the sample size calculation, that is p or (1-p), in any of the monitoring periods during the crediting period without having to revise the monitoring plan;[9]

(i)   CDM project activities or PoAs that are registered or have requested registration before the approval of version 3.0 of this standard, i.e. before 13 September 2012 with the interpretation of 10 per cent precision as an 'absolute' unit in the PDD or PoA-DD shall apply the requirement of 'relative' unit for the precision through a revision of the sampling plan no later than by 13 September 2015. The procedures for post registration changes indicated in the "CDM project cycle procedure" shall be followed to update the monitoring plans.

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[4]   See Definitions for essential sampling terminology.

[5]   Sampling may also be employed by DOEs to assess compliance with requirements, validity of assumption or other information used within PDDs or monitoring reports (e.g. biomass availability, information on prevailing practice).

[6]   Minimum frequency of survey efforts to be undertaken for the purposes of monitoring and the use of the survey results for the respective monitoring reports are indicated in the methodologies or in the general guidelines to small scale methodologies.

[7]   The reliability of a sample-based estimate depends on both the numerical size of the sample and the variability associated with the parameter of interest. The larger the sample size the greater the reliability, whereas the relationship with the variability is the opposite, i.e. the more variable the parameter the less reliable the estimate. If a parameter has a large amount of variability, increasing the sample size will help to increase the reliability. An assessment of the variability will also deliver information on the need for stratification.

[8]   If there is more than one parameter to be estimated in a CDM project activity, then a sample size calculation should be done for each of them. Then either the largest number for the sample size is chosen for the sampling effort with one common survey or the sampling effort and survey is repeated for each of the parameters.

[9]   The check on meeting the reliability requirement should be based on the larger of the two proportions.

(b) As a *relative* term *when the parameter of interest is a mean.* For example, ±10% in relative terms means that the interval around a mean value of 4 is 3.6 to 4.4.

12. When developing a sampling plan, project proponents shall calculate the sample size required to achieve a required level of reliability. The sample size should be determined manually or using appropriate statistical software. The calculation is dependent on all of the following as well as the target level of confidence and the precision (e.g. 90/10 or 95/10):[10]

(a) The type of parameter of interest, i.e. mean value or proportion value;

(b) The target value, i.e. the expected value of the parameter, which should be determined using the project planner's knowledge and experience;[11]

(c) Expected variance (or standard deviation)[12] for that measure in the sample, based on results from similar studies including other similar CDM projects or previous monitoring periods, pilot studies,[13] or from the project planner's own knowledge of the data.[14]

If the sample size calculation returns a value of less than 30 samples, a minimum sample size of 30 shall be chosen when the parameter of interest is a proportion.[15] If the parameter of interest is a numeric mean value (i.e. not a proportion or percentage) the Student's t-distribution shall be used if the resulting sample size is less than 30.

13. Subject to the two requirements of unbiased estimates and achieving reliability levels for the specific parameter determination, project participants have broad discretion in the sampling approach they propose to use to obtain the estimates. The choice depends on several considerations, including the known characteristics of the population, the cost of information -gathering, and other conditions surrounding the project in question. Some of the most commonly used sampling methods are summarized in "Guidelines for sampling and surveys for CDM project activities and programme of activities", along with typical circumstances where each may be most appropriate to apply.

14. Some CDM methodologies specify minimum required levels of precision and confidence for various categories of variables estimated by sampling. The samples shall be chosen

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[10] It is good practice to employ oversampling at the design stage, not only to compensate for any attrition, outliers or non-response associated with the sample, but also to prevent a situation at the analysis stage where the required reliability is not achieved and additional sampling efforts would be required. This would then be expensive, time-consuming and inconvenient.

[11] For example, 80% of households will still have an operational cooker, the average household size is 4.5.

[12] The variance is denoted by σ^2 (or s^2), and the standard deviation by σ or s. The standard deviation is the square root of the variance.

[13] Project participants may conduct a sample campaign before the monitoring period to determine the standard deviation.

[14] If the parameter of interest is a proportion, or a percentage, then expected variance can be derived directly from the target value referred under paragraph 12(b) above.

[15] This is to approximate normal, for example in cases where a very high value is anticipated for the proportion of interest (that is p>0.9 such as when 99% of CFLs are functional) when calculations would return extremely small sample size.

so as to meet or exceed these minimum levels. Project proponents may request a revision of these requirements in the methodology or request a deviation from the approved methodology in accordance with the relevant procedures providing sufficient justifications as to why a lower level is suitable for the planned application.

15. In addition to the parameters specifically indicated in CDM methodologies that are to be determined through sampling, project participants may propose to obtain estimates of other variables using sampling techniques if that is the only practical or cost-effective means to obtain them. In those instances, project proponents shall request a revision of methodology or request deviation from the methodology or request a clarification using the approved procedures before developing a sampling plan.

16. If the estimates from the actual samples fail to achieve the target minimum levels of precision,[16] project participants shall either;

   (a) Perform additional data collection that is a supplemental or new sample to reach the required precision level; or

   (b) Apply a correction to the estimates using one of the two options below[17]:

      (i) Discounting the emission reduction estimates by either,

         a. Taking the lower or the upper bound, whatever is conservative, of the 90 or 95 per cent confidence interval, depending on the type of methodologies applied; or

         b. Discounting by no less than three times (x3) the percentage precision points missed (e.g. if the attained precision is 90/11 then the emission reduction estimates are discounted by 3 per cent);

      (ii) Using a conservative default value included in the applied methodologies (e.g. 3.5 hours for lighting usage for AMS-II.J, default failure rates[18] provided in equation 3 of AMS-II.J).

   (c) Option 16 (b) is only eligible for application to the survey undertaken during the first two years of the crediting period of the project activity or CPAs (if sampling is undertaken at the PoA level the two year limit applies from the start date of crediting to the PoA) and when the attained precision from the actual samples is equal to or better than 90/15 for small-scale and 95/15 for large-scale project activities.

17. When sampling is undertaken, unless differently specified in the methodology applied, the sample mean (or proportion) value shall be used for the emissions reduction calculation, not the lower or upper bound of the confidence interval.

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[16] The range of confidence and precision of data collected through sampling should be computed to see if the stipulated requirements in paragraph 10 are met.

[17] Procedures for "temporary deviation from the monitoring plan as described in the registered PDD, PoA-DD, generic CPA-DD, or the monitoring methodology" of the CDM Project cycle procedure do not need to be applied for this case.

[18] Default values chosen should be conservative, for example by applying the failure rates of year X+2 for year X using the calculation method indicated in equation 3.

18.	The recommended outline of a sampling plan is specified in "Guidelines for sampling and surveys for CDM project activities and programme of activities". In all of the approaches, it shall be ensured that the samples are drawn in a manner that avoids any bias and that the data collection minimizes non-sampling (non-random, systematic) errors. In order to achieve these goals, practitioners should observe sound practices in designing samples and administering surveys and field measurements as indicated in "Guidelines for sampling and surveys for CDM project activities and programme of activities".

# 5.	Sampling requirements for PoAs

19.	This section covers specific sampling requirements for PoAs for application by a CME to estimate parameter values through sampling.

20.	Parameter values shall be estimated by sampling in accordance with the requirements in the applied methodology separately and independently for each of the CPAs included in a PoA except when a single sampling plan covering a group of CPAs[19] is undertaken applying 95/10 confidence/precision[20] for the sample size calculation.

# 6.	Validation and verification of sampling plans of project activities and PoAs

21.	The proposed sampling plans shall be validated by DOEs[21] to determine whether they will provide parameter value estimates in an unbiased and reliable manner including determining:

(a)	Whether the proposed sample size and sampling method is adequate to achieve the minimum confidence/precision requirements. DOEs shall be able to reproduce the sample size calculation in order to validate the proposed sample size;

(b)	Whether the proposed sampling plan will ensure that samples are randomly selected and are representative of the population.

22.	DOEs shall verify whether the project proponents have implemented the sampling effort and surveys according to the validated sampling plans. The verification includes determining:

(a)	Whether the required confidence/precision has been met;

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[19] That is, the populations of all CPAs in the group are combined together, the sample size is determined and a single survey is undertaken to collect data e.g. if the parameter of interest is the daily usage hours of light bulbs, it may be feasible to undertake a single sampling and survey effort spread across geographic regions of several CPAs when either homogeneity of included CPAs relative to the light usage hours can be demonstrated or the differences among the included CPAs is taken into account in the sample size calculation. Currently PoAs applying large scale CDM methodologies are not included for applying single sampling plan covering a group of CPAs pending further analysis.

[20] This is consistent with the approach in many approved methodologies to aim at higher confidence/precision when the sampling/survey effort is undertaken less frequently e.g. AMS-I.E, AMS-II.G or AMS-I.J.

[21] Recommended evaluation criteria are included in "Guidelines for sampling and surveys for CDM project activities and programme of activities".

(b)   Whether the selected sample was representative of the population.

23.   As one means of validation/verification a DOE may apply a sampling approach when the project proponents have not applied a sampling approach provided that samples are randomly selected and are representative of the population. However, the DOE may choose a different confidence/precision than the ones indicated in paragraph 10.

24.   When a sampling approach is applied by the project proponents, the DOE may use acceptance sampling as described in below steps (paragraphs 25-28 below) as part of validation[22]/verification activities to meet the requirements of paragraph 21 and 22 above:

(a)   Take a random sample of the PPs sample records;

(b)   Check – using own professional judgment – the acceptability (or otherwise) of the data for each record in the PPs sample records, and then;

(c)   Based on the number of records where there is agreement, determine if the PPs sample records meet the requirements.

25.   In order to determine the size of the sample for field/onsite check, the DOE should specify in advance, using own professional judgment:

(a)   Acceptable quality level or the Level of Assurance, i.e. the proportion of discrepancies between the PP sample records and the DOE sample records (i.e. DOE field/onsite inspection results) that are acceptable, e.g. 1%;

(b)   The proportion of discrepancies between the PP sample record and DOE sample records that are unacceptable, e.g. 20%.

26.   The maximum errors associated with the determination indicated in paragraph 25 should remain at levels indicated below:

(a)   A 10% chance that the DOE will wrongly reject the PPs records (i.e. reject a set of records of acceptable quality);[23]

(b)   A 10% chance that the DOE will wrongly accept the PPs records (i.e. accept a set of records which is unacceptable).[24]

27.   Using provisions under paragraphs 25 to 26 the DOE should determine:

(a)   n: the size of the sample;[25]

(b)   c: the acceptance number.

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[22] Assessment of parameters determined ex ante by the project proponents is included.

[23] This is called the *producer's risk.*

[24] This is called the *consumer's risk.*

[25] A DOE shall determine a sample size for each parameter. If there are multiple parameters, the DOE should take the largest sample size from the different parameters, for example if the sample size for parameter-1 is 50 and sample size for parameter-2 is 55, sample size chosen to cover both the parameters is 55.

28. If the DOE observes greater than c discrepant records in the sample then the PPs set of records is not accepted. If the number of discrepant records is equal to or less than c then the PPs set of records is accepted. "Table 1. Sample size and acceptance number based on producer and consumer risk" may be used as reference.

29. A DOE may select a different sample size than the one indicated in paragraph 27, either by choosing a different value for the consumer risk and producer risk (e.g. 20% for the consumer risk) when applying acceptance sampling or by using another approach, if any of the following conditions apply:

    (a) The estimated volume of annual emission reductions of the project activity or the PoA being verified is equal to or less than 100,000 tCO2e; or

    (b) The security conditions in the project region prevents inspection of many samples (e.g. conflict zones); or

    (c) The project activity or the PoA is located in a least developed country or a host Party with 10 or less registered CDM project activities at the end of the monitoring period being verified.

Table 1   Sample size and acceptance number based on AQL, UQL, and producer and consumer risk

| | | Producer risk 5% | | Producer risk 5% | | Producer risk 5% | | Producer risk 5% | |
| | | consumer risk 5% | | consumer risk 10% | | consumer risk 15% | | consumer risk 20% | |
AQL	UQL	Sample size (n)	Acceptance number (c)	Sample size (n)	Acceptance number (c)	Sample size (n)	Acceptance number (c)	Sample size (n)	Acceptance number (c)
0.5%	10%	46	1	38	1	33	1	29	1
0.5%	15%	30	1	25	1	22	1	10	0
0.5%	20%	22	1	18	1	9	0	8	0
1.0%	10%	61	2	52	2	33	1	29	1
1.0%	15%	30	1	25	1	22	1	19	1
1.0%	20%	22	1	18	1	16	1	14	1

Producer risk		10%		10%		10%		10%	
consumer risk		5%		10%		15%		20%	
AQL	UQL	Sample size (n)	Acceptance number (c)	Sample size (n)	Acceptance number (c)	Sample size (n)	Acceptance number (c)	Sample size (n)	Acceptance number (c)
0.5%	10%	46	1	38	1	19	0	16	0
0.5%	15%	19	0	15	0	12	0	10	0
0.5%	20%	14	0	11	0	9	0	8	0
1.0%	10%	46	1	38	1	33	1	29	1
1.0%	15%	30	1	25	1	22	1	10	0
1.0%	20%	22	1	18	1	9	0	8	0

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Document information

Version	Date	Description
04.0	26 July 2013	EB 74 Annex 6
		Revision to include the requirements for programme of activities:
		• To include discounting approaches to meet the reliability requirements for the survey;
		• To clarify the requirements on application of relative precision;
		• To include more options for sampling for validation and verification.
03.0	13 September 2012	EB 70, Annex 6
		Revisions are:
		• To clarify that greater of the two proportions (success or failure rate), should be used in the sample size calculations;
		• To specify a minimum sample size of 30;
		• To allow the use of data from other CDM projects or other monitoring periods to estimate standard deviation as an option;
		• To clarify circumstances under which discounting or the lower bound or upper bound around the mean can be employed;
		• To clarify that acceptance sampling by the DOE to verify the sampling records of the project proponent is optional;
		• To move the appendix 1 to this standard to the new section of "Definitions";
		• To delete all other appendices to include them in the "Guidelines for sampling and surveys for CDM project activities and programme of activities".
02.0	25 November 2011	EB 65, Annex 2
		To include:
		• Requirements for large-scale projects and PoAs;

Version	Date	Description
		• Sampling related specifications on validation/verification of CDM projects and PoAs by a DOE; • Title change due to new content in document. This document supersedes General guidelines for sampling and surveys for SSC project activities (version 01.0) (Annex 30, EB 50 meeting report). Due to the overall modification of the document, no highlights of the changes are provided.
01.0	23 October 2009	EB 50, Annex 30 Initial adoption.

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