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Draft Standard

Sampling and surveys for CDM project activities and programmes of activities

Version 06.0

DRAFT



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1. Introduction

1. This document includes the requirements for sampling and surveys applied to clean development mechanism (CDM) project activities and programmes of activities (PoAs).

2. Scope and applicability

2. This standard is applicable to CDM project participants, coordinating/managing entities (CMEs) of PoAs and designated operational entities (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 PoAs¹ with any requirements specified in the applied methodologies having precedence. Sampling—This document also provides for sampling-related requirements pertaining to validation and verification are also included including the sampling approach to be undertaken by the validating/verifying DOEs. A definition of essential sampling terminology is contained in section 3 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 greenhouse gas (GHG) emission reductions achieved by a CDM 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

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

efficiency of replaced equipment, to estimate the characteristics of an 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 (GHG) 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, that is, as a percentage of the anticipated target value. These standards use relative units for the 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 project design documents (PDDs), CDM programme of activities design documents (CDM-PoA-DDs), or component project activity design documents (CDM-CPA²-DDs) utilizing sampling for the determination of parameter values for calculating GHG emission reductions shall include³ a sampling plan⁴ with a description of the

²—CPA stands for component project activity.

³ As per the requirements in section 7.2.8 of the relevant sections of the “CDM project standard for project activities” or “CDM project standard for programmes of activities”, the project participants or the CME may choose to submit the monitoring plan (of which sampling plan is a part) for the proposed CDM project activity, PoA or CPA either at the time of validation or: (a) at any time prior to the submission of request for issuance for the first monitoring period; or (b) together with the request for issuance for the first monitoring period.

- sampling approach, important assumptions, and justification for the selection of the chosen approach.
8. The purpose of sampling is to obtain: (a) unbiased and (b) reliable estimates⁵ of the mean value of parameters used in the calculations of GHG emission reductions.⁶
 9. Requirements for sampling are defined either in the applicable CDM methodology or in the paragraphs below, with the ~~applicable~~ **applied** methodology having precedence.
 10. Where there is no specific guidance in the ~~applicable~~ **applied** methodology, the project participants **or the coordinating/managing entity** shall use 90/10 confidence/precision as the criteria for reliability of sampling efforts for small-scale CDM project activities and 95/10 for large-scale CDM project activities.⁷ This reliability specification shall be applied to determine the sampling requirements for each individual parameter value determined through a sampling effort.^{8, 9}
 11. Precision of 10 per cent, that is, $\pm 10\%$ in this standard shall be interpreted:
 - (a) As a relative unit when the parameter of interest is a proportion (or a percentage). For instance, $\pm 10\%$ 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 **(p)** or the failure rate **(1-p)** – for example (i) cookstove still operational or (ii) cookstove no longer operational. ~~Project proponents~~ **The project participants or the coordinating/managing entity** may use the larger of the two proportions in the sample size calculation, that is p or (1-p),

⁴ 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 the CDM project cycle procedure.

⁵ See Definitions for essential sampling terminology.

⁶ 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).

⁷ 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.

⁸ 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.

⁹ 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. A random sub-sample within the common survey is allowed as long as: (i) the reliability specification (e.g. 90/10 confidence/precision for small-scale project activities and 95/10 for large-scale project activities) is achieved for each individual parameter, and (ii) the random sub-sample is consistent with the design of the survey and the corresponding sample size calculation.

in any of the monitoring periods during the crediting period without having to revise the monitoring plan;¹⁰

- (i) CDM project activities or PoAs that are registered or have requested for registration before the approval of version 3.0 of this standard, that is, 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 for project activities" or the "CDM project cycle procedure for programmes of activities" shall be followed to update the monitoring plans;
 - (b) As a relative term when the parameter of interest is a mean. For example, $\pm 10\%$ 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~~ the project participants or the coordinating/managing entity 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):¹¹
- (a) The type of parameter of interest, that is, mean value or proportion value;
 - (b) The target value, that is, the expected value of the parameter, which should be determined using the project participant's or the coordinating/managing entity's knowledge and experience;¹²
 - (c) Expected variance (or standard deviation)¹³ for that measure in the sample, based on the results from similar studies including other similar CDM project activities or previous monitoring periods, pilot studies,¹⁴ or from the project planner's own knowledge of the data.¹⁵

¹⁰ The check on meeting the reliability requirement should be based on the larger of the two proportions.

¹¹ 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.

¹² For example, 80% of households will still have an operational cooker, the average household size is 4.5.

¹³ 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.

¹⁴ Project participants may conduct a sample campaign before the monitoring period to determine the standard deviation.

¹⁵ 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.

13. 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.¹⁶ 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.
14. Subject to the two requirements of unbiased estimates and achieving reliability levels for the specific parameter determination, the project participants **or the coordinating/managing entity** 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 the "Guideline: Sampling and surveys for CDM project activities and programmes of activities", along with typical circumstances where each may be most appropriate to apply.
15. Some CDM methodologies specify minimum required levels of precision and confidence for various categories of variables estimated by sampling. The samples shall be chosen so as to meet or exceed these minimum levels. ~~Project proponents~~ **The project participants or the coordinating/managing entity** 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.
16. In addition to the parameters specifically indicated in CDM methodologies that are to be determined through sampling, the project participants **or the coordinating/managing entity** 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~~ **the project participants or the coordinating/managing entity** shall request a revision of the methodology, request deviation from the methodology, or request a clarification, in accordance with the relevant procedures before developing a sampling plan.
17. If the estimates from the actual samples fail to achieve the target minimum levels of precision,¹⁷ the project participants **or the coordinating/managing entity** 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:¹⁸

¹⁶ 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.

¹⁷ 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.

¹⁸ 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.

- (i) Discounting the emission reduction estimates by either:
 - a. Taking the lower or the upper bound, whatever is the more 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 required precision is 90/10 and 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 rates¹⁹ provided in equation 3 of AMS-II.J);
 - (c) The option in subparagraph (b) above is only eligible for the application to the survey undertaken during the first two years of the crediting period of the CDM 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 a small-scale CDM project activity and 95/15 for a large-scale CDM project activity.
18. When sampling is undertaken, unless otherwise specified in the methodology applied, the sample mean (or proportion) value shall be used for the emission reduction calculation, not the lower or upper bound of the confidence interval.
19. The recommended outline of a sampling plan is specified in the “Guideline: Sampling and surveys for CDM project activities and programmes 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~~ the project participants or the coordinating/managing entity should observe sound practices in designing samples and administering surveys and field measurements as indicated in the “Guideline: Sampling and surveys for CDM project activities and programmes of activities”.

5. Sampling requirements for PoAs

20. This section covers specific sampling requirements for a PoA for application by the coordinating/managing entity to estimate parameter values through sampling.
21. 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 the PoA except when a single sampling plan covering a group of CPAs is undertaken applying 95/10 confidence/precision²⁰ for the sample size calculation. In the latter case, 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; for example if the

¹⁹ 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.

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.

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. Several groups of CPAs may be formed and the sample sizes may be calculated for each group. Currently PoAs applying large-scale CDM methodologies are not included for applying a single sampling plan covering a group of CPAs pending further analysis.

22. In the case of CPAs solely composed of “microscale CDM units” as defined under the section “Application of microscale thresholds at unit level for CPAs” of the [draft revised] in the “Methodological tool: “Demonstration of additionality of microscale project activities”, 95/10 confidence/precision shall be applied for sampling surveys in all cases, even when they are conducted at the CPA level.

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

23. The proposed sampling plan shall be validated by a DOE²¹ 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. The DOE 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.
24. The DOE shall verify whether the project proponents—participants or the coordinating/managing entity have implemented the sampling—effort and surveys according to the validated—registered sampling plan. The verification includes determining:
- (a) Whether the required confidence/precision has been met;
 - (b) Whether the selected sample was representative of the population.
25. The DOE may apply a sampling approach for on-site visits and/or remote surveys as part of validation/verification, applying the “Guideline: Sampling and surveys for CDM project activities and programme of activities”, irrespective of whether above-mentioned sampling plan exists or the project participants or the coordinating/managing entity have undertaken sampling surveys.
26. As one means of validation/verification a DOE may apply a sampling approach When the project proponents—participants or the coordinating/managing entity have not applied a sampling approach However, the DOE may apply a sampling approach choosing a

²¹ Recommended evaluation criteria are included in “Guideline: Sampling and surveys for CDM project activities and programmes of activities”.

- different confidence/precision than the ones indicated in paragraph 10 above, provided that samples are randomly selected and are representative of the population.
27. When a sampling approach is applied by the ~~project proponents~~ project participants or the coordinating/managing entity, the DOE may use acceptance sampling as described in the steps indicated in paragraphs 28–33 below as part of validation²²/verification activities. ~~to meet the requirements of paragraph 21 and 23 above~~
28. For applying acceptance sampling, the DOE should follow the steps below:
- (a) Take a random sample of the project participants' or the coordinating/managing entity's sample records;
 - (b) Check – using its own professional judgement – the acceptability (or otherwise) of the data for each record in the project participants' or the coordinating/managing entity's sample records; and then
 - (c) Based on the number of records where there is agreement, determine whether the project participants' or the coordinating/managing entity's sample records meet the requirements.
29. In order to determine the size of the sample ~~for field/on-site check~~, the DOE should specify in advance, using its own professional judgement:
- (a) Acceptable quality level or the Level of Assurance, i.e. the proportion of discrepancies between the project participants' or the coordinating/managing entity's sample records and the DOE sample records (i.e. DOE field/on-site inspection results) that are acceptable (e.g. 1%);
 - (b) The proportion of discrepancies between the project participants' or the coordinating/managing entity's sample records and DOE sample records that are unacceptable (e.g. 20%).
30. The maximum errors associated with the determination indicated in paragraph 29 above should remain at levels indicated below:
- (a) A 10% chance that the DOE will wrongly reject the project participants' or the coordinating/managing entity's records (i.e. reject a set of records of acceptable quality);²³
 - (b) A 10% chance that the DOE will wrongly accept the project participants' or the coordinating/managing entity's records (i.e. accept a set of records which is unacceptable).²⁴
31. Using provisions under paragraphs 29 and 30 above, the DOE should determine:
- (a) n: the size of the sample;²⁵

²² Assessment of parameters determined ex ante by the project ~~proponents~~ participants or the coordinating/managing entity is included.

²³ This is called the “producer’s risk”.

²⁴ This is called the “consumer’s risk”.

- (b) c: the acceptance number.
32. If the DOE observes greater than c discrepant records in the sample then the project participants' or the coordinating/managing entities' set of records is not accepted. If the number of discrepant records is equal to or less than c then the project participants' or the coordinating/managing entities' set of records is accepted. Table 1 below, "Sample size and acceptance number based on producer and consumer risk" may be used as reference.
33. A DOE may select a different sample size than the one indicated in paragraph 31 above, 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 GHG 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 fewer 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%		5%		5%		5%	
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	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)

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.

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

<i>Version</i>	<i>Date</i>	<i>Description</i>
06.0	17 October 2016	Published as an annex to the annotated agenda of EB92. Revision to include more options (e.g. remote surveys) for sampling-based approach for validations and verifications by DOEs.
05.0	16 October 2015	EB86, Annex 3. Revision to: <ul style="list-style-type: none"> Clarify the timing submitting a sampling plan for the case of the delayed submission of a monitoring plan by project proponents in line with section 7.2.8 of the CDM Project Standard, and; Clarify the requirements for sampling and survey when there is more than one parameter to be estimated in a CDM project activity.
04.1	28 November 2013	Editorial revision to correct a reference in document information table.
04.0	26 July 2013	EB 74, Annex 6. Revision to include the requirements for programme of activities: <ul style="list-style-type: none"> 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 69, Annex 4. Revisions are: <ul style="list-style-type: none"> 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;

<i>Version</i>	<i>Date</i>	<i>Description</i>
		<ul style="list-style-type: none"> • 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	<p>EB 65, Annex 2.</p> <p>To include:</p> <ul style="list-style-type: none"> • Requirements for large-scale projects and PoAs; • Sampling related specifications on validation/verification of CDM projects and PoAs by a DOE; • Title change due to new content in document. <p>This document supersedes General guidelines for sampling and surveys for SSC project activities (version 01.0) (Annex 30, EB 50 meeting report).</p> <p>Due to the overall modification of the document, no highlights of the changes are provided.</p>
01.0	23 October 2009	<p>EB 50, Annex 30.</p> <p>Initial adoption.</p>
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