CLEAN DEVELOPMENT MECHANISM

CDM-MP97-A02

Draft Small-scale Methodology

Emission reduction by application of Dry-cultivated Water-saving and Drought-resistance Rice (D-WDR) in rice cultivation

Version 03.0

Sectoral scope(s): 15

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The proposed new methodology SSC-NM108 was received on 21 December 2022 and deemed complete on 16 January 2023, and first time assessed at MP90, the MP agreed to request clarifications and revisions to the methodology proponent.

2. The submission was further considered as assessed at MP91 to MP96 and further issues were raised.

3. The submission was considered two times by the Executive Board of the clean development mechanism (the Board) firstly at EB 121 and then at EB 124 and requested the MP to address the issues its ide The Board considered the proposed methodology and identified issues to be addressed by the MP.

2. Purpose

4. The methodology applies to project activities introducing Dry-cultivated Water-saving and Drought-resistance rice (D-WDR) in existing flooded rice cultivars within the host country.

3. Key issues and proposed solutions

5. The MP revised the methodology addressing the key issues from EB 121 and EB 124 as follows:

   (a) The term “cultivation practice” is consistently used across the methodology, replacing the terms “cultivation pattern”, “cultivation method” and “farmland management practices” that were included in the original submission;

   (b) The introduced cultivation practices, including specific cultivation elements, technologies and crop protection products, shall not be subject to any regulatory restrictions. Further, the baseline cultivation practices shall not be subject to any regulatory restrictions and the project cultivation practices are not mandated by any regulation;

   (c) Remote sensing is introduced as a measure to determine key factors, such as the cultivated area, and the baseline cultivation practice for all project fields;

   (d) The use of the DNDC model was removed as an option from the methodology, as the use of the model is for non-commercial purposes only;

   (e) A conservative approach for the estimation of baseline emissions and project emission factor is introduced in the draft methodology, taking into account the uncertainty (lower bound for Baseline Emissions and upper bound for Project emissions);

   (f) The provisions to calculate project emissions resulting from potential losses of soil organic carbon (SOC) caused by the implementation of the project activity are introduced in the draft methodology. The guidance for the measurements of SOC

has been improved, including reference to ISO and FAO protocols. The clarity of the approach has been enhanced and a specific monitoring parameter has been included;

(g) The guidance for the determination of the reference fields has been consistently applied in the draft methodology, including further guidance for the sizing of the reference fields;

(h) A flexibility for the selection of the method to determine the baseline and project emission factors is introduced in the draft methodology and the prioritization of methods has been removed;

(i) The methodology is only applicable

(i) When it can be demonstrated that the project cultivar achieves at least the same level of yield as the baseline cultivar and therefore provisions to address potential leakage in case of unforeseen reasons have been removed; and

(ii) If the introduced cultivation practices, including specific cultivation elements, technologies are not subject to any regulatory restrictions, and crop protection products (herbicides or pesticides) do not exceed any regulatory thresholds or standards. The quantity of pesticides used should not increase as a result of the project activity.

4. Impacts

6. The new methodology will allow the estimation of emission reductions for project activities implementing Dry-cultivated Water-saving and Drought-resistance rice (D-WDR) in existing flooded rice fields and facilitate their implementation in the host country.

5. Subsequent work and timelines

7. The methodology is recommended by the MP for consideration by the Board at its 125th meeting. No further work is envisaged.

6. Recommendations to the Board

8. The MP recommends the Board to approve the new methodology, to be made effective at the time of the Board's approval.

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1. Introduction

1. The following table describes the key elements of the methodology:

Table 1. Methodology key elements

Typical project(s)	Rice cultivars introducing Dry-cultivated Water-saving and Drought-resistance rice (D-WDR) in rice cultivation.
Type of GHG emissions mitigation action	Greenhouse gas (GHG) emission avoidance: Reduced anaerobic decomposition of organic matter in rice cropping soils

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology covers project activities introducing Dry-cultivated Water-saving and Drought-resistance rice (D-WDR) in existing flooded rice cultivars.

2.2. Applicability

3. The methodology applies to project activities introducing Dry-cultivated Water-saving and Drought-resistance rice (D-WDR) in existing flooded rice cultivars within the host country.

4. This methodology is applicable under the following conditions:

(a) The baseline rice cultivation in the project area involves irrigated, flooded fields for an extended period of time during the growing season. This shall be demonstrated using field records and remote sensing (e.g. satellite/aerial images) for each field implemented under the project activity.

(b) Project activities shall be implemented in upland areas. The methodology does not apply to farms with baseline water regimes classified as upland rice or rainfed rice and deep-water rice[1].

(c) The cultivar implemented by the project activity shall be identified as drought resistant in accordance with a relevant international standard.[2]

(d) No D-WDR has been planted within the project boundary prior to the implementation of the project.

(e) It is demonstrated that the project cultivar achieves at least the same level of yield as the baseline cultivar. This shall be demonstrated at validation.[3]

[1] Deep water rice refers to varieties of rice (Oryza sativa) grown in flooded conditions with water more than 50 cm (20 in) deep for at least a month.

[2] For example, the “Technical specification of identification and evaluation for rice drought resistance (NY/T2863-2015)”.

[3] For example, using pilot studies, experimental data from field or laboratory tests.

(f) The implementation of the project activity does not require changes in the original farmland management practices[4].

(g) The project participants shall avoid double counting of emission reductions, through a contractual agreement with the owner of the land/cultivar.

(h) The project participants shall provide training and technical support during the cropping season, including in field preparation, irrigation, drainage and use of fertilizer. This shall be documented in a verifiable manner (e.g. protocol of trainings, documentation of on-site visits).

(i) The introduced cultivation practices, including specific cultivation elements, technologies are not subject to any regulatory restrictions, and crop protection products (herbicides or pesticides) do not exceed any regulatory thresholds or standards.

5. Aggregated annual emission reductions of all fields included under a project activity shall be less than or equal to 60 kt CO_2 equivalent.

2.3. Entry into force

6. The date of entry into force is the date of the publication of the EB ### meeting report on # Month 2025.

2.4. Applicability of sectoral scopes

7. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology, application of sectoral scope 15 is mandatory.

3. Normative references

8. This methodology is based on the proposed small-scale methodology “SSC-NM108: Emission reduction by application of Dry-cultivated Water-saving and Drought-resistance Rice (D-WDR) in rice cultivation” submitted by Shanghai Academy of Agricultural Sciences.

9. Project participants shall apply the General guidelines for SSC CDM methodologies and the CDM TOOL21 for demonstration of additionality of SSC project activities.

10. This methodology refers to the latest approved versions of the following methodology and tools:

(a) “AMS-III.AU.: Methane emission reduction by adjusted water management practice in rice cultivation” (hereinafter referred to as AMS-III.AU.);

(b) “AMS-III.BF.: Reduction of N2O emissions from use of Nitrogen Use Efficient (NUE) seeds that require less fertilizer application” (hereinafter referred to as AMS-III.BF.);

(c) “TOOL24: Common practice” (hereinafter referred to as TOOL24).

[4] Except for water usage, fertilizer usage and type of herbicide.

4. Definitions

11. The definitions contained in the Glossary of CDM terms shall apply.

12. For the purpose of this methodology the following definitions apply:

(a) **Cultivation practice** - a set of elements of a cultivation practice which mainly consists of the irrigation method, field preparation, fertilization and weed and pest control.

(b) **Water-saving and Drought-resistance rice (WDR)** - a variety of rice that can grow under rain-fed or dry cultivation systems with minimal standing water, maintaining soil in aerobic condition.

(c) **Flooded** - a type of water regime in which fields are flooded for a significant period of time.

(d) **Rainfed** - a type of water regime which depends solely on precipitation.

(e) **Upland** - a high-lying area of land that is above the level of flooding. Uplands can include hills, mountains, plateaus, and other elevated regions.

13. The project field(s) shall be categorized within groups (***g***) according to their baseline cultivation practices following Table 2 below.

Table 2. Parameters for the definition of baseline cultivation practices

No	Parameter	Type	Attributes	Source/method
1	Water regime-on season	Dynamic	Continuously flooded	~~Baseline:~~ Monitoring or 2019 Refinement to the 2006 IPCC Guidelines
			Single Drainage	
			Multiple Drainage	
2	Water regime-pre-season	Dynamic	Flooded	~~Baseline:~~ Monitoring or 2019 Refinement to the 2006 IPCC Guidelines
			Short drainage (<180d)	
			Long drainage (>180d)	
3	Organic amendment	Dynamic	Straw on-season[5]	~~Baseline:~~ Monitoring or 2019 Refinement to the 2006 IPCC Guidelines
			Green manure	
			Straw off-season[1]	
			Farm yard manure	
			Compost	
			No organic amendment	

5. Baseline methodology

5.1. Project boundary

14. The spatial extent of the project boundary covers the area of each and every field where Dry-cultivated Water-saving and Drought-resistance rice (D-WDR) is introduced under the project activity.

[5] Straw on-season means straw applied just before rice season, and straw off-season means straw applied in the previous season. Rice straw that was left on the surface and incorporated into soil just before the rice season is classified as straw on-season.

15. The project boundary shall be delineated as follows:

    (a) Use Global Positioning System (GPS), Satellite Navigation System (Compass) or other satellite-based systems to determine the coordinates of each plot boundary of the project, and the positioning error should not exceed 5 meters; and

    (b) Use a large-scale topographic map (scale not less than 1:10000) or a georeferenced map to delineate each plot area (by identifying the coordinates of all vertices of the plot area), and combine with GPS, Compass and other positioning systems for precision control. The unplanted areas such as roads, irrigation canals and ridges between the plots should be excluded when the area is delineated.

5.2. Baseline scenario and additionality

16. The baseline scenario of a small-scale CDM project activity implemented under this methodology shall be the continuation of the pre-project cultivar, water regime and cultivation practice. This methodology is only applicable to project activities where the baseline scenario is traditional rice cultivation with continuous flooding or flooding with single or multiple drainage. The baseline scenario shall be identified through historical cultivation records and remote sensing.

17. The historical cultivation records shall include rice cultivar, frequency and volume of irrigation water, types and amounts of fertilizer, pesticide types and amounts and rice yields.

18. The project participants shall demonstrate that the total volume of irrigation water consumed by the baseline rice cultivation during the entire growth period is not less than the local rice irrigation water quota, according to the agricultural irrigation water quota issued by national or local authorities or benchmark defined by an international standard. The project participants shall provide vegetation indices and water-related indices time series derived from remote imagery (satellite or aerial photographs) or other appropriate data three years prior to the start of the project activity.

19. Project participants shall apply the general guidelines for the SSC CDM methodologies and “TOOL21: Demonstration of additionality of small-scale project activities”.

20. The project proponent shall assess whether the proposed project activity is common practice in accordance with “TOOL24: Common practice”.

5.3. Baseline emissions

21. The baseline emissions shall be calculated on a seasonal basis as follows:

$$BE_y = \sum_s BE_s \quad \text{Equation (1)}$$

$$BE_s = \sum_s (BE_{s,CH4} + BE_{s,N2O}) \quad \text{Equation (2)}$$

$$BE_{s,CH4} = \sum_{g=1}^{G} EF_{BL,s,g,CH4} \times \min(A_{s,g}, A_{s,bsl}) \times 10^{-3} \times GWP_{CH4} \quad \text{Equation (3)}$$

$$BE_{s,N2O} = \sum_{g=1}^{G} EF_{BL,s,g,N2O} \times \min(A_{s,g}, A_{s,bsl}) \times 10^{-3} \times GWP_{N2O}$$ Equation (4)

Where:

BE_y	=	Baseline emissions in year y (tCO_2e)
BE_s	=	Baseline emissions from project fields in seasons *s* (tCO_2e)
$BE_{s,CH4}$	=	Baseline methane emissions from project fields in season *s* (tCO_2e)
$BE_{s,N2O}$	=	Baseline nitrous oxide emissions from project fields[6] in season *s* (tCO_2e)
$EF_{BL,s,g,CH4}$	=	Baseline methane emission factor of group *g* in season *s* ($kgCH_4$/ha per season)
$EF_{BL,s,g,N2O}$	=	Baseline nitrous oxide emission factor of group *g* in season *s* (kgN_2O/ha per season)
$A_{s,g}$	=	Aggregated project area in a given season *s* (ha)
$A_{s,bsl}$	=	Area of the baseline cultivar replaced by the project activity (ha)
GWP_{CH4}	=	Global warming potential of CH_4 (tCO_2e /tCH_4)
GWP_{N2O}	=	Global warming potential of N_2O (tCO_2e/tN_2O))
g	=	Group g, cover all project fields with the same cultivation practice as determined as per Table 2

22. The baseline emission factors shall be determined as per one of the approaches below ~~(in order of priority)~~[7]:

    (a) Measurements on reference fields;

    (b) Calculation based on regional or global default values.

5.3.1. Measurement on reference fields

23. The baseline reference fields shall be set up in such a way that they are representative of baseline emissions in the project rice fields. For every 10 hectares within each group of fields with the same cultivation practice (Table 2), a minimum of three reference fields of at least 0.3 hectares each shall be determined in the project area. On these fields, measurements using the closed chamber method shall be carried out for estimation of baseline methane emission factor and baseline nitrous oxide emission factor, each resulting in an emission factor expressed in $kgCH_4$/ha or kgN_2O/ha per season.

24. The emission factor $EF_{BL,s,g}$ shall be derived as average value from the three measurements of each group, in accordance with the methods specified in the Guidelines on methane measurement, contained in the Appendix to small-scale CDM methodology AMS-III.AU. When following the procedures contained in the Appendix, project participants shall undertake an *ex-ante* baseline campaign during at least ten consecutive

[6] According to the several studies, D-WDR may lead to an increase of nitrous oxide emissions.

[7] The approach applied for the baseline emission factor shall be consistent with the approach chosen for the project emission factor.

days for each reference field during a period that is identified as the coldest of the season, based on 5 years of historical weather data.

25. The nitrous oxide emission factor is measured in the same way as methane. In order to account for uncertainty, where parameter values are derived from sample surveys undertaken within the project area, a conservative estimate of the baseline emission factors shall be used by adopting the value that represents the lower bound of the 95 percent confidence interval (i.e. sample mean - 1.96 × standard error).

5.3.2. Calculation based on regional or global default values

26. The baseline methane emission factor is estimated *ex-ante* by taking the lower bound of the error range for the applicable default values provided in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tier 1 (Table 5.11, Volume 4 chapter 5). Uncertainty shall be accounted in the determination of the baseline methane daily emission factor, adjusted for project fields (equation 6).[8] The lower bound of uncertainty range shall be applied for the baseline methane daily emission factor adjusted for project fields in equation 5.

27. The baseline methane emission factor is calculated as follows:

$$EF_{BL,CH4} = EF_{BL,CH4,d} \times d \qquad \text{Equation (5)}$$

$$EF_{BL,CH4,d} = EF_C \times SF_W \times SF_P \times SF_O \qquad \text{Equation (6)}$$

$$SF_O = (1 + \sum_i ROA_i \times CFOA_i)^{0.59} \qquad \text{Equation (7)}$$

Where:

$EF_{BL,CH4}$	=	Baseline methane daily emission factor adjusted for project fields ($kgCH_4/ha/day$)
d	=	Cultivation period of rice in year y (days/year)
EF_C	=	Baseline methane emission factor for continuously flooded fields without organic amendments ($kgCH_4/ha/day$)
SF_W	=	Baseline scaling factors to account for the differences in water regime during the cultivation period
SF_P	=	Baseline scaling factors to account for the differences in water regime in the pre-season before the cultivation period
SF_O	=	Baseline scaling factors; varies for both type and amount of organic amendment applied
ROA_i	=	Application rate of organic amendment type I, in dry weight for straw and fresh weight for others

[8] Error propagation shall be applied in line with the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

$CFOA_i$ = Conversion factor for organic amendment type I (in terms of its relative effect with respect to straw applied shortly before cultivation

28. The baseline nitrous oxide emission factor is calculated as follows:

$$EF_{BL,N2O} = EF_{BL,N2O,FR} \times F_{N,BL} \times MW_{N2O} \quad \text{Equation (8)}$$

$$F_{N,BL} = F_{SN,BL} + F_{ON,BL} + F_{CR,BL} \quad \text{Equation (9)}$$

Where:

$EF_{BL,N2O}$ = Baseline nitrous oxide emission factor ($kgN_2O/ha/season$)

$EF_{BL,N2O,FR}$ = Default value of emission factor for nitrous oxide emission caused by nitrogen input into flood project field in baseline scenario (kgN_2O - N/kgN)

$F_{N,BL}$ = Total amount of organic N fertilizer applied to soils in baseline scenario (kgN/season)

MW_{N2O} = Molecular weight ratio of N_2O: N (44/28) (kgN_2O /kg-N)

$F_{SN,BL}$ = Amount of synthetic fertilizer N applied to souls in baseline scenario (kgN/season)

$F_{ON,BL}$ = Amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils in baseline scenario (kgN/season)

$F_{CR,BL}$ = Nitrogen in crop residues (above and below group) before rice season in baseline scenario (kg/season)

29. $EF_{BL,N2O.FR}$ shall be determined by taking the lower bound of the uncertainty range of the default emission factor in Table 11.1 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 11.

5.4. Project emissions

30. The project CH_4 and N_2O emissions from project fields are calculated on a seasonal basis as follows:

$$PE_y = \sum_s PE_s \quad \text{Equation (10)}$$

$$PE_s = \sum_s (PE_{s,CH4} + PE_{s,N2O}) \quad \text{Equation (11)}$$

$$PE_{s,CH4} = \sum_{g=1}^{G} EF_{PJ,s,g,CH4} \times A_{s,g} \times 10^{-3} \times GWP_{CH4} \quad \text{Equation (12)}$$

$$PE_{s,N2O} = \sum_{g=1}^{G} EF_{PJ,s,g,N2O} \times A_{s,g} \times 10^{-3} \times GWP_{N2O} \quad \text{Equation (13)}$$

Where:

PE_y	=	Project emissions in year y (tCO_2e)
PE_s	=	Project emissions from project field in season s (tCO_2e)
$PE_{s,CH4}$	=	Project methane emissions from field in season s (tCO_2e)
$PE_{s,N2O}$	=	Project nitrous oxide emissions from project fields in season s (tCO_2e)
$EF_{PJ,s,g,CH4}$	=	Project methane emission factors factor of group g in season s ($kgCH_4$/ha per season)
$EF_{PJ,s,g,N2O}$	=	Project nitrous oxide emission factor of group g in season s (kgN_2O/ha per season)

31. The project emission factor shall be determined as per one of the approaches below ~~(in order of priority)~~. Project participants shall use the upper bound of uncertainty interval.

    (a) Measurement on reference fields;

    (b) Calculation based on regional or global default values.

5.4.1. Measurement on reference fields

32. The seasonally integrated project emission factor $EF_{PJ,s,g}$ for methane and nitrous oxide shall be determined using measurements on at least three project reference fields of at least 0.3 hectares each, for every 10 hectares within the group that fulfil the same conditions as the baseline reference fields. Project reference fields shall be established close to the baseline reference fields and start the growing season at the same time.

33. Measurements shall be taken using the closed chamber method, in accordance with the methods specified in the Guidelines on methane measurement, contained in the Appendix to small-scale CDM methodology AMS-III.AU (Nitrous oxide emission factor shall be measured in the same way as methane). $EF_{PJ,s,g}$ is the average of the measurements from the reference fields, expressed in $kgCH_4$/ha and kgN_2O/ha per season. For the uncertainty estimation, a conservative estimate of project emissions shall be made by adopting a value that represents the upper bound of the 95 percent confidence interval (i.e. sample mean + 1.96 × standard error).

5.4.2. Calculation based on regional or global default values

34. The project methane emission factor is estimated by taking the upper bound of the uncertainty range of the default values provided in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tier 1. Combined uncertainty[9] shall be accounted in the determination of the project methane daily emission factor adjusted for project fields. The upper bound of uncertainty range shall be applied for the project methane daily emission factor adjusted for project fields in equation 14.

35. The project methane emission factor is calculated as follows:

$$EF_{PJ,CH4} = EF_{PJ,CH4,d} \times d \qquad \text{Equation (14)}$$

[9] Error propagation shall be applied in line with the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Where:

$EF_{PJ,CH4,d}$	=	Project methane daily emission factor adjusted for project fields ($kgCH_4$/ha/day)
d	=	Cultivation period of rice in year y (days/year)

36. According to equation (6) and the scaling factor (SF_w) from Table 5.12 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 5, SF_w for upland is 0. Therefore, $EF_{PJ,CH4,d}$ is 0, and it can be claimed that the project methane emission factor under project activity is 0 for upland.

37. The project nitrous oxide emission factor is calculated as follows:

$$EF_{PJ,N2O} = EF_{PJ,N2O,FR} \times F_{N,PJ} \times MW_{N2O} \quad \text{Equation (15)}$$

$$F_{N,PJ} = F_{SN,PJ} + F_{ON,PJ} + F_{CR,PJ} \quad \text{Equation (16)}$$

Where:

$EF_{PJ,N2O}$	=	Project nitrous oxide emission (tCO_2e)
$EF_{PJ,N2O,FR}$	=	Default value of emission factor for nitrous oxide emission caused by nitrogen input into flood project field in project scenario (kgN_2O-N/kgN)
$F_{N,PJ}$	=	Total amount of organic N fertilizer applied to soils in project scenario (kgN/season)
$F_{SN,PJ}$	=	Amount of synthetic fertilizer N applied to souls in project scenario (kgN/season)
$F_{ON,PJ}$	=	Amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils in project scenario (kgN/season)
$F_{CR,PJ}$	=	Nitrogen in crop residues (above and below group) before rice season in project scenario (kg/season)

38. $EF_{PJ,N2O.FR}$ shall be determined taking into account the higher default value of upland rice within emission factor uncertainty range in Table 11.1 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 11.

5.4.3. Project emissions resulting from loss of soil organic carbon

39. The project participants shall take into account potential losses of soil organic carbon (SOC) caused by the implementation of the project activity as follows:

    (a) Measuring the SOC before the implementation of the project activity; and

    (b) Monitoring SOC losses every five years since the implementation of the project activity; or

    (c) Applying a default yearly discount of 5% for losses of soil organic carbon.

40. The loss of organic carbon between measurements shall be compared with the total amount of discounted emission reductions, and in case the measured loss of SOC is

higher than the discounted amount, the balance shall be further discounted from the amount of emission reductions to be issued in the year when the measurement took place.

~~5.5. Leakage~~

~~41. In cases where the yield of the project fields (kg/ha) is lower than in the baseline due to unforeseen reasons, the leakage from an increase in the planting area of the baseline rice cultivar outside the project boundary shall be calculated. The theoretical planting area of baseline rice cultivars outside the project boundary shall be calculated as follows:~~

$$A_{s,theoretical} = (P_{bsl,traditional\ rice} - P_{pj,D-WDR})/P_{bsl,traditional\ rice} \times A_{s,bst}$$ ~~Equation (17)~~

~~Where:~~

$A_{s,theoretical}$	=	~~The theoretical planting area of baseline rice cultivars outside the project boundary (ha)~~
$P_{bsl,traditional\ rice}$	=	~~Yield of the baseline cultivar replaced by the project activity (kg/ha)~~
$P_{pj,D-WDR}$	=	~~Yield of the project D-WDR (kg/ha)~~
$A_{s,bst}$	=	~~Area of the baseline cultivar replaced by the project activity (ha)~~

~~42. The leakage emissions generated by the theoretical planting area of baseline rice cultivars outside the project boundary (LE_y) shall be calculated as follows:~~

$$LE_y = \sum_s LE_s$$ ~~Equation (18)~~

$$LE_s = \sum_s (LE_{s,CH4} + LE_{s,N2O})$$ ~~Equation (19)~~

$$LE_{s,CH4} = \sum_{g=1}^{G} EF_{BL,s,g,CH4} \times A_{s,theoretical} \times 10^{-3} \times GWP_{CH4}$$ ~~Equation (20)~~

$$LE_{s,N2O} = \sum_{g=1}^{G} EF_{BL,s,g,N2O} \times A_{s,theoretical} \times 10^{-3} \times GWP_{N2O}$$ ~~Equation (21)~~

~~Where:~~

LE_y	=	~~Baseline emissions in year y (tCO_2e)~~
LE_s	=	~~Baseline emissions from project fields in seasons *s* (tCO_2e)~~
$LE_{s,CH4}$	=	~~Baseline methane emissions from project fields in season *s* (tCO_2e)~~
$LE_{s,N2O}$	=	~~Baseline nitrous oxide emissions from project fields[10] in season *s* (tCO_2e)~~
$EF_{BL,s,g,CH4}$	=	~~Baseline methane emission factor of group g in season *s* ($kgCH_4$/ha per season)~~

[10] According to the several studies, D-WDR may lead to an increase of nitrous oxide emissions.

~~$EF_{BL,s,g,N2O}$~~	=	~~Baseline nitrous oxide emission factor of group g in season s (kgN_2O/ha per season)~~
~~$A_{s,theoretical}$~~	=	~~The theoretical planting area of baseline rice cultivars outside the project boundary (ha)~~
~~GWP_{CH4}~~	=	~~Global warming potential of CH4 (tCO_2e / tCH_4)~~
~~GWP_{N2O}~~	=	~~Global warming potential of N2O (tCO_2e /tN_2O))~~
~~g~~	=	~~Group g, cover all project fields with the same cultivation practice as determined as per Table 2 (G=total number of groups)~~

6. Monitoring methodology

43. The following parameters shall be monitored as per the tables below. Relevant requirements in the "General guidelines for SSC CDM methodologies" (e.g. calibration requirements, sampling requirements) apply.

6.1. Data and parameters not monitored

Data / Parameter table 1.

Data / Parameter:	***GWP*$_{CH4}$**
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of CH_4
Source of data:	IPCC Fifth Assessment Report (AR5) default value
Measurement procedures (if any):	Any future revision of the IPCC's Assessment Report should be taken account
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	***GWP*$_{N2O}$**
Data unit:	tCO_2e/tN_2O
Description:	Global warming potential of N_2O
Source of data:	IPCC Fifth Assessment Report (AR5) default value
Measurement procedures (if any):	Any future revision of the IPCC's Assessment Report should be taken account
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	***EF*$_c$**
Data unit:	$kgCH_4$/ha/day
Description:	Baseline emission factor for continuously flooded fields without organic amendments
Source of data:	Table 5.11 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 5

Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	SF_W
Data unit:	-
Description:	Baseline scaling factors to account for the differences in water regime during the cultivation period
Source of data:	Table 5.12 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 5
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	SF_P
Data unit:	-
Description:	Baseline scaling factors to account for the differences in water regime in the pre season before the cultivation period
Source of data:	Table 5.13 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 5
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	ROA_i
Data unit:	t/ha
Description:	Application rate of organic amendment type i, in dry weight for straw and fresh weight for others
Source of data:	Agricultural management record
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	$CFOA_i$
Data unit:	-
Description:	Conversion factor for organic amendment type i (in terms of its relative effect with respect to straw applied shortly before cultivation
Source of data:	Table 5.14 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 5

Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 8.

Data / Parameter:	$EF_{BL,N2O.FR}$
Data unit:	$kgN_2O\text{-}N/kgN$
Description:	Default value of emission factor for nitrous oxide emission caused by nitrogen input into flooded project field in baseline scenario
Source of data:	Table 11.1 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 11
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	$F_{SN,BL}$
Data unit:	kgN/season
Description:	Amount of synthetic fertiliser N applied to soils in baseline scenario
Source of data:	Agricultural management record
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	$F_{ON,BL}$
Data unit:	kgN/season
Description:	Amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils in baseline scenario
Source of data:	Agricultural management record
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 11.

Data / Parameter:	$F_{CR,BL}$
Data unit:	kg/season
Description:	Nitrogen in crop residues (above and below ground) before rice season in baseline scenario
Source of data:	Agricultural management record
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 12.

Data / Parameter:	MW_{N2O}
Data unit:	$kgN_2O/kg\text{-}N$
Description:	Molecular weight ratio of N_2O and N (44/28)
Source of data:	-
Measurement procedures (if any):	-
Any comment:	-

Data / Parameter table 13.

Data / Parameter:	$EF_{PJ,N2O,FR}$
Data unit:	$kgN_2O\text{-}N/kgN$
Description:	Default value of emission factor for nitrous oxide emission caused by nitrogen input into project field in project scenario
Source of data:	Table 11.1 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 11
Measurement procedures (if any):	-
Any comment:	-

6.2. Data and parameters monitored

Data / Parameter table 14.

Data / Parameter:	$A_{s,g}$
Data unit:	ha
Description:	Aggregated project area in a given season s
Source of data:	-
Measurement procedures (if any):	To be determined by collecting the project field sizes in a project database. The size of project fields shall be determined by GPS or satellite data.
Monitoring frequency:	Every season
QA/QC procedures:	-
Any comment:	Only compliant farms are considered

Data / Parameter table 15.

Data / Parameter:	$EF_{BL,CH4,d}$
Data unit:	$kgCH_4/ha/day$
Description:	Baseline methane daily emission factor adjusted for project fields
Source of data:	-
Measurement procedures (if any):	Option (a): As per the procedure contained in the appendix of AMS-III.AU Option (b): As per 2019 Refinement to the 2006 IPCC Guidelines

Monitoring frequency:	Regular measurements as per closed chamber method guidance from AMS-III.AU.
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 16.

Data / Parameter:	$EF_{BL.N2O}$
Data unit:	$kgN_2O/ha/season$
Description:	Baseline nitrous oxide emission factor
Source of data:	-
Measurement procedures (if any):	Option (a): As per the procedure contained in the appendix of AMS-III.AU. Option (b): As per 2019 Refinement to the 2006 IPCC Guidelines
Monitoring frequency:	Regular measurements as per closed chamber method guidance from AMS-III.AU.
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 17.

Data / Parameter:	$EF_{PJ.N2O}$
Data unit:	$kgN_2O/ha/season$
Description:	Project nitrous oxide emission factor
Source of data:	-
Measurement procedures (if any):	Option (a): As per the procedure contained in the appendix of AMS-III.AU. Option (b): As per 2019 Refinement to the 2006 IPCC Guidelines
Monitoring frequency:	Regular measurements as per closed chamber method guidance from AMS-III.AU.
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 18.

Data / Parameter:	***d***
Data unit:	Days/year
Description:	Cultivation period of rice in year y
Source of data:	-
Measurement procedures (if any):	To be determined using cultivation logbooks
Monitoring frequency:	Every year
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 19.

Data / Parameter:	**Sowing date**
Data unit:	-
Description:	-
Source of data:	Agricultural records for each plot or farmer visits
Measurement procedures (if any):	-
Monitoring frequency:	Every planting season
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 20.

Data / Parameter:	**Cultivation practice**
Data unit:	-
Description:	Application of fertilizer, organic amendments or crop protection measures, and water regime
Source of data:	Agricultural records for each plot
Measurement procedures (if any):	-
Monitoring frequency:	Every planting season
QA/QC procedures:	-
Any comment:	Amount and date shall be recorded

Data / Parameter table 21.

Data / Parameter:	$P_{pj.\ D\text{-}WDR}$
Data unit:	kg/ha
Description:	Yield of the project D-WDR
Source of data:	Agricultural records for each plot
Measurement procedures (if any):	-
Monitoring frequency:	Every planting season
QA/QC procedures:	To be crosschecked with sales records.
Any comment:	-

Data / Parameter table 22.

Data / Parameter:	$P_{bsl.\ traditional\ rice}$
Data unit:	kg/ha
Description:	Yield of the baseline cultivar replaced by the project activity
Source of data:	Agricultural records for each plot
Measurement procedures (if any):	-
Monitoring frequency:	Every planting season

QA/QC procedures:	-
Any comment:	-

Data / Parameter table 23.

Data / Parameter:	$A_{s,bsl}$
Data unit:	ha
Description:	Area of the baseline cultivar replaced by the project activity
Source of data:	-
Measurement procedures (if any):	To be determined by collecting the baseline field sizes based on the area of each cultivar that is displaced by the project activity. The size of baseline fields shall be determined by GPS or satellite data.
Monitoring frequency:	Every season
QA/QC procedures:	-
Any comment:	Only compliant farms are considered

Data / Parameter table 24

Data / Parameter:	$F_{SN,PJ}$
Data unit:	kgN/season
Description:	Amount of synthetic fertiliser N applied to soils in project scenario
Source of data:	Agricultural management record
Measurement procedures (if any):	-
Monitoring frequency:	Every season
QA/QC procedures:	To be crosschecked with invoices for fertilizer purchases
Any comment:	-

Data / Parameter table 25

Data / Parameter:	$F_{ON,PJ}$
Data unit:	kgN/season
Description:	Amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils in project scenario
Source of data:	Agricultural management record
Measurement procedures (if any):	-
Monitoring frequency:	Every season
QA/QC procedures:	To be crosschecked with invoices for fertilizer purchases
Any comment:	-

Data / Parameter table 26

Data / Parameter:	$F_{CR,PJ}$
Data unit:	kg/season
Description:	Nitrogen in crop residues (above and below ground) before rice season in project scenario
Source of data:	Agricultural management record
Measurement procedures (if any):	-
Monitoring frequency:	Every season
QA/QC procedures:	To be crosschecked with invoices for fertilizer purchases
Any comment:	-

Data / Parameter table 27

Data / Parameter:	***SOC***
Data unit:	kg/season
Description:	Soil organic carbon
Source of data:	
Measurement procedures (if any):	Measurements shall be undertaken in line with ISO 23400:2021 "Guidelines for the determination of organic carbon and nitrogen stocks and their variations in mineral soils at field scale" or FAO "A protocol for measurement, monitoring, reporting and verification of soil organic carbon in agricultural landscapes" (these documents provide guidance/guidelines for the sampling design).
Monitoring frequency:	Before the implementation of the project activity, and every five years since the implementation of the project activity.
QA/QC procedures:	-
Any comment:	-

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Document information

Version	*Date*	*Description*
03.0	6 May 2025	MP 97, Annex 2 To be considered by the Board at EB 125. This version addresses the feedback provided by the Board at EB 124 (EB 124 meeting report, para. 34).
02.0	5 March 2025	MP 96, Annex 1 To be considered by the Board at EB 124. The changes in this draft methodology are not highlighted as this document has been fully revised to address the issues raised by the Board at EB 121.
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