CLEAN DEVELOPMENT MECHANISM

CDM-MP93-A03

Draft Small-scale Methodology

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

Version 01.0

Sectoral scope(s): 15

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The proposed new methodology "SSC-NM108: Emission reduction by application of Dry-cultivated Water-saving and Drought-resistance Rice (D-WDR)" in rice cultivation was submitted by Shanghai Academy of Agricultural Sciences in December 2022.

2. Purpose

2. The methodology covers project activities introducing Dry-cultivated Water-saving and Drought-resistant rice (D-WDR) to substitute existing flooded rice cultivars within the host country.

3. Key issues and proposed solutions

3. The methodology is applicable under the following conditions:

   (a) The Baseline involves irrigated, flooded fields (upland, rainfed and deep water rice are not eligible). This shall be demonstrated for all fields;

   (b) The drought resistance of cultivar shall be identified according to a relevant international or national standard;

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

   (d) The project activity does not lead to a decrease in rice yield, nor does it require changes of farmland management practices;

   (e) In case the project participant is not the land owner, double counting of emission reductions shall be avoided through a contractual agreement with the owner or the land/cultivar.

4. Impacts

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

5. Subsequent work and timelines

5. The draft version of the methodology is recommended by the Methodologies Panel (MP) for consideration by the Board at its 121st meeting. No further work is envisaged.

6. Recommendations to the Board

6. The MP recommends that the Board adopt this 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)	Introducing Dry-cultivated Water-saving and Drought-resistance rice (D-WDR) cultivars 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) cultivars to substitute existing flooded rice cultivars.

2.2. Applicability

3. This methodology is applicable under the following conditions:

   (a) The project activity introduces D-WDR cultivars substituting existing flooded rice cultivars;

   (b) The baseline rice cultivation in the project area involves irrigated, flooded fields for an extended period of time during the growing season. Therefore, farms whose water regimes can be classified as upland rice or rainfed rice and deep water rice[1] are not eligible to apply this methodology. This shall be demonstrated using satellite or aerial (remote sensing) images for each field implemented under the project activity. This project area characterization shall also include information on pre-season water regime and applied organic amendments, so that all dynamic parameters as shown in Table 2 below are covered by the baseline study；

   (c) The drought resistance cultivar implemented by the project activity shall be identified according to a relevant international or national standard[2];

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

   (e) The implementation of the project activity does not lead to a decrease in rice yield[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, "Technical specification of identification and evaluation for rice drought resistance (NY/T2863-2015).

[3] In case the yield of the project fields (kg/ha) is lower than the baseline in a certain year during the crediting period due to unforeseen reasons, leakage shall be considered.

(f) The implementation of the project activity does not require changes in the original farmland management practices, except for water usage, nitrogen fertilizer usage and type of herbicide;

(g) In case the project participant is not the land owner, double counting of emission reductions shall be avoided through a contractual agreement with the owner or the land/cultivar;

(h) The project participant 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 and crop protection products, are not subject to any regulatory restrictions.

4. 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

5. The date of entry into force is the date of the publication of the EB XX meeting report on DDMonthYYYY.

2.4. Applicability of sectoral scopes

6. 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

7. 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.

8. The project participants shall apply the General guidelines for SSC CDM methodologies and the “TOOL21: Demonstration of additionality of small-scale project activities” (hereinafter referred to as TOOL21) for demonstration of additionality of SSC project activities.

9. 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 N_2O 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. Definitions

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

11. 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** - a variety of rice that can grow under rain-fed or dry cultivation systems with minimal standing water, maintaining soil aerobic conditions;

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

(d) **Irrigated** - a type of water regime in which fields are flooded for a significant period of time and water regime is fully controlled;

(e) **Rainfed** - a type of water regime which depends solely on precipitation;

(f) **Upland** - a type of water regime in which fields are not flooded for a significant period of time.

12. The project field(s) shall be categorized and grouped according to their cultivation patterns following the classification provided in Table 2 below.

Table 2. Parameters for the definition of cultivation patterns

No	Parameter	Type	Values/categories	Source/method
1	Water regime-on season	Dynamic	Continuously flooded	Baseline: Statistical yearbooks, agricultural records or farmer visits Project: Monitoring
			Single Drainage	
			Multiple Drainage	
2	Water regime-pre-season	Dynamic	Flooded	Baseline: Statistical yearbooks, agricultural records or farmer visits Project: Monitoring
			Short drainage (<180d)	
			Long drainage (>180d)	
3	Nitrogen fertilizer application-on season	Dynamic	<100 kg N/ha	Baseline: Statistical yearbooks, agricultural records or farmer visits Project: Monitoring
			100~200 kg N/ha	
			200~300 kg N/ha	
			>300 kg N/ha	
4	Soil Organic Carbon	Static	<1%	National data or ex ante measure
			1~3%	
			>3%	

No	Parameter	Type	Values/categories	Source/method
5	Organic Amendment	Dynamic	Straw on-season[4]	Baseline: Statistical yearbooks, agricultural records or farmer visits Project: Monitoring
			Green manure	
			Straw off-season[1]	
			Farm yard manure	
			Compost	
			No organic amendment	
6	Soil pH	Static	<4.5	ISRIC-WISE soil property database[5] or national data
			4.5-5.5	
			>5.5	
7	Climate	Static	AEZ[6]	Rice Almanac, HarvestChoice

5. Baseline methodology

5.1. Project boundary

13. The geographic boundary encompasses the rice fields where rice cultivar, the cultivation method and water regime are changed. The spatial extent of the project boundary includes all fields that change the cultivation method in the context of the project activity.

14. The project boundaries shall be delineated using one of the following methods:

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

    (b) Use a large-scale topographic map (scale not less than 1:10000) to delineate the field 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

15. The baseline scenario of a small-scale project activity implemented under this methodology shall be the continuation of the pre-project cultivar, water regime and cultivation method. 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.

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[4] 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.

[5] For these static parameters, refer to appropriate global or national data. The database from ISRIC provides soil data which can be used for this purpose.

[6] Climate zone: use agroecological zones as shown in the Rice Almanac (Third Edition, 2002), or by HarvestChoice.

16. 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. The project participant shall demonstrate that the total irrigation water volume consumed by baseline traditional rice during the entire growth period is not less than local rice irrigation water quota according to the agricultural irrigation water quota issued by national or local authorities or any other international or national standard or peer reviewed publications. The project participant shall provide vegetation indices and water-related indices time series derived from remote imagery (satellite or aerial photographs) dating three years prior to the start of the project activity.

17. The project participants shall apply the general guidelines for the SSC CDM methodologies and TOOL21.

18. The project proponent shall assess whether the proposed project activity is common practice in accordance with TOOL24.

5.3. Baseline emissions

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

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

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

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

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

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[7] in season *s* (tCO_2e)
$EF_{BL,s,g,CH4}$	=	Baseline methane emission factor of group *g* in season *s* (kgCH4/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)

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

GWP_{N2O}	=	Global warming potential of N_2O (tCO_2e /tN_2O))
g	=	Group *g*, cover all project fields with the same cultivation pattern as determined as per Table 2 (G=total number of groups)

20. The baseline emission factor shall be determined as per one of the approaches below (in order of priority)[8]:

(a) Measurement on reference fields;

(b) Estimation using the DeNitrification-DeComposition (DNDC) model;

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

5.3.1. Measurement on reference fields.

21. The baseline reference fields shall be set up in a way that they are representative of baseline emissions in the project rice fields. For each group of fields with the same cultivation pattern (Table 2), at least three reference fields with the same pattern 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 as $kgCH_4/ha$ or kgN_2O/ha per season. The seasonally integrated baseline emission factor $EF_{BL,s,g}$ shall be derived as average value from the three measurements for 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. The measurement process can be referred to Appendix "Guidelines for measuring methane emissions from rice fields" of AMS-III.AU. Nitrous oxide 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 baseline emissions by adopting a value that represents the lower bound of the 95 percent confidence interval (i.e. sample mean - 1.96 × standard error).

5.3.2. Estimation using the DNDC model

22. A calibrated DNDC model shall be used to estimate the CH_4 and N_2O emissions under the baseline scenario. The calibrated DNDC model requires input of a variety of parameters, including soil parameters such as soil texture, bulk density, and soil organic carbon content, as well as farmland management measures such as tillage, fertilization, and irrigation. Input parameters should be measured on site. When simulating the baseline scenario, crop parameters, water management and fertilizer application need to be input as per the actual situation. For the uncertainty estimation, the process can be referred to Appendix 4 "Estimation of uncertainty in modelled emission" of CDM methodology AMS-III.BF.

5.3.3. Calculation based on regional or global default values:

23. The baseline emission factor is estimated *ex-ante* taking into account the lower default values provided in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tier 1. Combined uncertainty shall be accounted in the

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

determination of the baseline methane daily emission factor adjusted for project fields (equation 6).[9] The lower bound of uncertainty range shall be applied for the baseline methane daily emission factor adjusted for project fields in equation 5.

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

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

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

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

Where:

$EF_{BL,CH4}$	=	Baseline methane daily emission factor adjusted for project fields (kgCH4/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 (kgCH4/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 should vary 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
$CFOA_i$	=	Conversion factor for organic amendment type I (in terms of its relative effect with respect to straw applied shortly before cultivation

25. EF_c shall be determined taking into account the lower default value within error range in Table 5.11 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 5.

26. SF_W shall be determined taking into account the lower default value within error range in Table 5.12 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 5.

27. SF_p shall be determined taking into account the lower default value within error range in Table 5.13 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 5.

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

28. *$CFOA_i$* shall be determined taking into account the lower default value within error range in Table 5.14 of 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 5.

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

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

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

Where:

$EF_{BL,N2O}$	=	Baseline nitrous oxide emission factor (kgN2O/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 (kgN2O-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) (kgN2O/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)

30. *$EF_{BL,N2O.FR}$* shall be determined taking into account the lower default value 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. Project emissions

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

$$PE_y = \sum_s PE_s$$ Equation (10)

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

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

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

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

(a) Measurement on reference fields;

(b) Estimation using the DNDC model;

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

5.4.1. Measurement on reference fields

33. 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 that fulfil the same conditions as the baseline reference fields. Project reference fields shall be established close to the baseline reference fields and strart the growing season at the same time. 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 as $kgCH_4$/ha and kgN_2O/ha per season. For the uncertainty estimation, a conservative estimate of project emissions 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. Estimation using the DNDC model

34. The project participant can use calibrated DNDC model to estimate the CH_4 and N_2O emission under project scenario. The calibrated DNDC model requires input of a variety of parameters, including soil parameters such as soil texture, bulk density, and soil organic carbon content, as well as farmland management measures such as tillage, fertilization, and irrigation. Input parameters should be measured on site. When simulating the project activities, crop parameters, water management and fertilizer application need to be input as per the actual situation. For the uncertainty estimation, the process can be refereed to Appendix 4 “Estimation of uncertainty in modelled emission” of CDM methodology AMS-III.BF.

5.4.3. Calculation based on regional or global default values

35. The project emission factor is estimated taking into account the upper default values provided in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse

Gas Inventories, Tier 1. Combined uncertainty[10] 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.

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

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

Where:

$EF_{PJ,CH4,d}$	=	Project methane daily emission factor adjusted for project fields (kgCH4/ha/day)
d	=	Cultivation period of rice in year *y* (days/year)

37. According to the 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, the SF_w of the upland is 0, then $EF_{PJ,CH4,d}$ are 0, it can be claimed that the project methane emission factor under project activity is 0.

38. 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)

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

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

5.5. Leakage

40. 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:

$$A_{s,theoretical} = (P_{bsl,traditional\ rice} - P_{pj,D-WDR})/P_{bsl,traditional\ rice} \times A_{s,bsl}$$ 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)
$A_{s,g}$	=	Aggregated project area in a given season *s* (ha)
$A_{s,bsl}$	=	Area of the baseline cultivar replaced by the project activity (ha)

41. 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 in season *s* (tCO2e)
$EF_{BL,s,g,CH4}$	=	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* (kgN2O/ha per season)
GWP_{CH4}	=	Global warming potential of CH_4 (tCO_2e/tCH_4)
GWP_{N2O}	=	Global warming potential of N_2O (tCO_2e/tN_2O))

6. Monitoring methodology

42. The following parameters shall be monitored as per the tables below. The applicable requirements specified in the "General guidelines for SSC CDM methodologies" (e.g. calibration requirements, sampling requirements) shall be taken into account by the project participants.

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 5.12 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 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-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-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:	-

Data / Parameter table 14.

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):	-
Any comment:	-

Data / Parameter table 15.

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):	-
Any comment:	-

Data / Parameter table 16.

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):	-
Any comment:	-

6.2. Data and parameters monitored

Data / Parameter table 17.

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):	As per instructions in the appendix (Guidelines for measuring methane emissions from rice fields) from AMS-III.AU.; or As per the calibrated DNDC model
Monitoring frequency:	Regular measurements as per closed chamber method guidance from AMS-III.AU., seasonally integrated or regular estimation as per calibrated DNDC model
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 18.

Data / Parameter:	$EF_{BL.N2O}$
Data unit:	kgN_2O/ha/season
Description:	Baseline nitrous oxide emission factor
Source of data:	-
Measurement procedures (if any):	As per instructions in the appendix (Guidelines for measuring methane emissions from rice fields) from AMS-III.AU.; or As per the calibrated DNDC model
Monitoring frequency:	Regular measurements as per closed chamber method guidance from AMS-III.AU., seasonally integrated or regular estimation as per calibrated DNDC model
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 19.

Data / Parameter:	$EF_{PJ.N2O}$
Data unit:	kgN_2O/ha/season
Description:	Project nitrous oxide emission factor
Source of data:	-
Measurement procedures (if any):	As per instructions in the appendix (Guidelines for measuring methane emissions from rice fields) from AMS-III.AU.; or As per the calibrated DNDC model
Monitoring frequency:	Regular measurements as per closed chamber method guidance from AMS-III.AU., seasonally integrated or regular estimation as per calibrated DNDC model
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 20.

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 21.

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 22.

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

Data / Parameter table 23.

Data / Parameter:	**Cultivation practice**
Data unit:	-
Description:	Application of fertilizer, organic amendments or crop protection measures, and water regime
Source of data:	Agricultural records
Measurement procedures (if any):	-

Monitoring frequency:	Every planting season
QA/QC procedures:	-
Any comment:	Amount and date shall be recorded

Data / Parameter table 24.

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

Data / Parameter table 25.

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 history records or local statistical data from government, industry, published, academic or international organization (e.g. FAO) sources
Measurement procedures (if any):	-
Monitoring frequency:	Every planting season
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 26.

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

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Document information

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