25. Agriculture / Alternate Wetting and Drying in Rice Cultivation

1. Typical Project Outline

Projects to improve irrigation management practices such as alternate wetting and drying (AWD) in rice cultivation.

2. Applicability

Projects implement improved irrigation management practices such as AWD in rice cultivation to reduce methane (CH_4) emissions from soil.

1) In rice cultivation, implement improvements to irrigation management in at least one of the following:
   a) Alternate wetting and drying (AWD)
   b) A shortened period of flooded condition
   c) Direct seeded rice (DSR)
2) The annual frequency of rice cultivation on the target agricultural field must be the same as during the comparable historical period (e.g., conversion from triple-cropping to double-cropping is excluded).
3) The target agricultural fields shall be those where rice cultivation was being conducted prior to the start of the project.

This methodology is not applicable under the following conditions:

1) The project is expected to decrease in the rice productivity exceeding 5%, based on examples such as researches on the target area or similar regions.
2) Cultivation practices are introduced that result in material declines in soil organic carbon (SOC) stocks due to reductions in the carbon input rate to soils (e.g., increased rice straw removal, decreased application rate of compost)
3) Project changes off-season (i.e., outside of the rice cultivation period) management practices (e.g., fertilizer application rates, tillage, crop rotations and crop types).

3. Methodology of Emission Reduction Calculation

The emission reduction from the project activity is determined as the differences between GHG emissions from soil associated with conventional irrigation practices (emissions under the baseline scenario) and those associated with improved irrigation practices such as AWD (project emissions)[1].

Details of sources of each data in the following formulae are provided in "4. Data and Parameters for the Estimation".

$$ER_y = (BE_{area,y} - PE_{area,y}) \times A_{PJ}$$

ER_y : Emission reduction through the project in year y (t-CO_2e/y)

$BE_{area,y}$: GHG emission per unit area (ha) under the baseline scenario in year y (t-CO_2e/ha/y)

$PE_{area,y}$: GHG emission per unit area (ha) under the project scenario in year y (t-CO_2e/ha/y)

A_{PJ} : Area for implementing improved irrigation management in the project scenario in year y (ha)

(1) Calculation of Baseline Emission

For the targeted project, CH_4 emissions from soil are the primary GHG emissions, and therefore these are calculated.

In case if fertilizer application improvements are involved in the project, apply JICA Climate-FIT "24. Agriculture/Fertilizer Application Improvement" to calculate the amount of emission reductions.

[1] The target year shall be a representative year under average operation or an annual average of multiple years.

Baseline emissions (CH_4 emissions from soil) shall be calculated using the following formula.

$$BE_{area,y} = EF_{BL} \times L \times GWP_{CH4} \times 10^{-3}$$

$$EF_{BL} = EF_{BL,c} \times SC_{BL,w} \times SC_{BL,p} \times SC_{BL,o}$$

$$SC_{BL,o} = \left(1 + \sum_{a} \left(ROA_{a,BL} \times CFOA_a\right)\right)^{0.59}$$

EF_{BL} : Baseline methane emission factor for continuously flooded fields without organic amendments ($kgCH_4/ha/day$)

L : Rice cultivation days (period) in year y (days)

GWP_{CH4} : Global warming potential of CH_4

$EF_{BL,c}$: Baseline methane emission factor for continuously flooded fields without organic amendments

$SC_{BL,w}$: Baseline scaling factor to account for differences in water regime during the cultivation period

$SC_{BL,p}$: Baseline scaling factor to account for differences in water regime in the pre-season before the cultivation period

$SC_{BL,o}$: Baseline scaling factor to account for organic amendments

ROA_a : Baseline application rate of organic amendment type a (a1, a2, a3, ...), in dry weight for straw and fresh weight for others (t/ha)

$CFOA_a$: Conversion factor for organic amendment type a (a1, a2, a3, ...)

(2) Calculation of Project Emission

Project emissions shall be calculated for the same emission sources as the baseline emissions using the formulas indicated in (1). For all formulae, replace BE with PE and the subscript BL with PJ in the calculations.

4. Data and Parameters for the Estimation

Data	Description	Data Sources	
		For baseline emission calculation	For project emission calculation
A_{PJ}	Area for implementing improved irrigation management in the project scenario in year y (ha)	N/A	A planned value
$EF_{BL,c}$	Baseline methane emission factor for continuously flooded fields without organic amendments ($kgCH_4/ha/day$)	A default value (Table 18, Appendix) Use a "Regional" value corresponding to the target area.	
$SC_{BL,w}$	Baseline scaling factor to account for differences in water regime during the cultivation period	A default value (Table 19, Appendix) Use a value for either "Aggregated case" or "Disaggregated case", depending on the water management practice at the cultivation site.	
$SC_{BL,p}$	Baseline scaling factor to account for differences in water regime in the pre-season before the	A default value (Table 20, Appendix) Use a value for either "Aggregated case" or "Disaggregated case", depending on the water management practice at the cultivation site.	

	cultivation period		
$ROA_{a,BL}$	Baseline application rate of organic amendment type a (a1, a2, a3, ...), in dry weight for straw and fresh weight for others (t/ha)	A historical value or a planned value	A planned value
$CFOA_a$	Conversion factor for organic amendment type a (a1, a2, a3, ...)	A default value (Table 21, Appendix)	
L	Rice cultivation days (period) in year y (days)	A historical value or a planned value In case if it is difficult to set a value, choose a default value from the Table 5.11, Chapter 5, Volume 4 of "Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories".	
GWP_{CH4}	Global warming potential of CH_4	A default value (Table 13, Appendix)	

5. Others

(1) Project Boundary

The scope of GHG estimates covers agricultural land where rice cultivation is conducted under both the baseline scenario and the project scenario.

(2) Leakage

Regarding leakages, the VCS methodology (VM0051: Improved Management in Rice Production Systems, version 1.0), which is referred in developing this methodology, identifies potential impacts such as the introduction of new organic fertilizers from outside the project area and yield reductions. Through conducting detailed analysis, these impacts can be considered negligible under certain conditions. This methodology aims to provide an ex-ante estimate of GHG emission reductions through project implementation based on the information and data obtainable through FS surveys, etc. Therefore, these leakage are not considered in this methodology.

(3) Comparison with existing methodologies

In developing this methodology, the abovementioned VCS methodology was referenced. The logic of calculating GHG emission reductions in this methodology is similar to the VCS methodology.

However, emission sources, those are considered negligible compared to CH_4 emissions from soil (or sources where the difference between baseline and project is assumed to be small) (e.g., fossil fuel/electricity use by agricultural machinery, biomass combustion such as agricultural residues, lime application, etc.), are excluded from calculation, and the calculation method is simplified by using such as IPCC default values as much as possible.

(4) Revision history

Version	Year/Month	Revisions
7.0	March 2026	• Newly developed.