Information note

Top-down development of standardized approaches for determining methane emissions in rice field under AMS-III.AU

I. Background

1. CMP.6 requested the Executive Board of the clean development mechanism (hereinafter referred to as the Board) to develop standardized baselines (SB), as appropriate, in consultation with relevant designated national authorities (DNAs), prioritizing methodologies that are applicable to least developed countries (LDCs), small island developing states (SIDS), Parties with 10 or fewer registered CDM project activities as of 31 December 2010 and underrepresented project activity types or regions, inter alia, for energy generation in isolated systems, transport and agriculture.

2. The Board at its sixtieth meeting approved a new small-scale methodology AMS-III.AU "Methane emission reduction by adjusted water management practice in rice cultivation". The methodology is for measures that result in reduced anaerobic decomposition of organic matter in rice cropping soils and thus reduced generation of methane. The methodology requires the measurement of methane emissions from reference fields using closed chamber method and laboratory analysis.

3. Further the Board requested the CDM Small Scale Working Group (SSC WG) to explore the inclusion of default values for monitoring parameters in the methodology, where feasible, to reduce transaction costs related to monitoring.

4. As per the task of developing top-down small-scale methodologies using standardized approaches contained in the 2012 workplan of the SSC WG, the SSC WG considered an information note prepared by the secretariat with regard to standardized approaches for simplifying calculations in AMS-III.AU, focusing on approaches for deriving regional/country specific values for methane emissions in rice field.

II. Proposal on standardized approaches for region/country specific values for methane emissions in rice field

5. With reference to the standardized approaches, based on expert inputs, the SSC WG 36 considered the following methodological approaches for deriving specific default values of daily methane emission factor in rice field.

Calculation of daily methane emission factor

6. As per IPCC 2006, Adjusted Daily Emission factor (*EFi*) is calculated as follows:

$$EF_i = EF_c * SF_w * SF_p * SF_o * SF_{s,r} \qquad \textbf{(1)}$$

Where:

EF_i	Adjusted daily emission factor for a particular harvested area ($kgCH_4$/ha/day)
EF_c	Baseline emission factor for continuously flooded fields without organic amendments ($kgCH_4$/ha/day)
SF_w	Scaling factor to account for the differences in water regime during the cultivation period

SF_p Scaling factor to account for the differences in water regime in the pre-season before the cultivation period

SF_o Scaling factor should vary for both type and amount of organic amendment applied

$SF_{s,r}$ Scaling factor for soil type, rice cultivar, etc. if available

7. IPCC default for *EFc* assuming a no flooding period lasting for less than 180 days prior to rice cultivation (which often occur with double cropping), and continuously flooded during rice cultivation without organic amendments is as follows:

	EFc
CH_4 emission ($kgCH_4$/ha/day)	1.30

Source: IPCC 2006 Table 5.11

8. The emission factor (*EFc*) shall be multiplied by the cultivation period of rice (given in days) and by annual harvested area of rice for which the conditions of cultivation are used, to calculate the annual emissions.

9. IPCC default for *SFw* is as follows:

Water regime during the cultivation period		*SFw*
Irrigated	Continuously flooded	1
	Intermittently flooded - single aeration	0.60
	Intermittently flooded - multiple aeration	0.52

Source: IPCC 2006 Table 5.12

Intermittently flooded: fields have at least one aeration period of more than three days during the cropping season;

Single aeration: fields have a single aeration during the cropping season at any growth stage (except for end-season drainage);

Multiple aeration: fields have more than one aeration period during the cropping season (except for end-season drainage).

10. IPCC default for *SFp* is provided in the following table. For regions/countries where it can be demonstrated by host country governments that double cropping is practiced, a default value of 1.0 is used. Otherwise, 0.68 is used.

Water regime prior to rice cultivation	*SFp*
Non flooded pre-season < 180 days (indicating double cropping)	1
Non flooded pre-season > 180 days (indicating single cropping)	0.68

Source: IPCC 2006 Table 5.13

11. IPCC default for *SFo* is calculated as follows:

$$SF_o = \left(1 + \sum_i ROA_i * CFOA_i\right)^{0.59} \quad \textbf{(2)}$$

Where:

ROA_i	Application rate of organic amendment type *i*, in dry weight for straw and fresh weight for others, tonne ha^{-1}
$CFOA_i$	Conversion factor for organic amendment type *i* (in terms of its relative effect with respect to straw applied shortly before cultivation

12. *ROAi* = 5 tonne/ha of straw is assumed as the baseline quantity of organic amendment, because the value of leftover straw after harvest is in the range of 3 tonne/ha (when harvested manually to the ground level, leaving very little stubble and the root residues) to 7 tonne/ha (harvested mechanically leaving behind large amount of crop residues on the field).

13. *CFOAi* = 0.29 for the leftover straw incorporated long before (>180 days: considering a single crop) and *CFOAi* = 1 (<180 days: considering a double crop) are assumed for the following reasons.

14. For a single crop, where the rice straw is usually ploughed back to the soil after the harvest of the crop and as such rice straw is left for long time (i.e. rice straw is incorporated for a duration of >30 days before cultivation), the straw is already mineralized being left in the dry field and the readily fermentable C component of the rice straw is less at flooding. This gives rise to lesser methane production when the soil is flooded for cultivation, therefore, 0.29 is used.

15. On the contrary, when rice straw is incorporated for a duration <30 days before the cultivation (a double crop situation), the rice straw is still not mineralized and the readily fermentable C contents of the rice straw results in the formation of higher quantity of methane production. This is the reason for using large factor of 1.. Moreover, the soil characteristics when a second crop follows an earlier one favors larger methane production.

16. Accordingly,

$SFo = (1 + 5 \times 0.29)^{0.59} = 1.70$ (for single crop)

$SFo = (1 + 5 \times 1)^{0.59} = 2.88$ (for double crop)

17. The above equation is for rice straw only. To include other organic amendments following IPCC2006 Table 5.14, the data will be:

For compost, the *SFo* will be $(1 + C \times 0.05)^{0.59}$

For farm yard manure, the *SFo* will be $(1 + YM \times 0.14)^{0.59}$

For green manure, the *SFo* will be $(1 + GM \times 0.50)^{0.59}$

18. *SFs,r* for the soil type and rice cultivar is not considered due to lack of data.

19. Thus, calculation of Adjusted Daily Emission factor (*EFi*) ($kgCH_4$/ha/day) is summarized in the table below. The following two options are considered for using default values (both consider organic amendments to be only the rice straw on field):

Option 1: provides default values for baseline emissions

(a) For regions/countries where double cropping and continuous flooding is practiced: 3.74($kgCH_4$/ha/day);

(b) For regions/countries where single cropping and continuous flooding is practiced: 1.50(kgCH4/ha/day).

Option 2: provides default values for both baseline emissions and project emissions. Under the Option 2, project developers are no longer required to conduct CH4 emission measurements in the project activity and are only required to monitor the cultivation practices in project area once this default emission reduction factor is included in the methodology.

(a) For regions/countries where double cropping is practiced, default values for emission reductions are:

(i) Scenario 1: change to intermittent flooded (single aeration): 1.50 ($kgCH_4$/ha/day);

(ii) Scenario 2: change to intermittent flooded (multiple aeration) : 1.80 ($kgCH_4$/ha/day);

(b) For regions/countries where single cropping is practiced, default values for emission reductions are:

(i) Scenario 1: change to intermittent flooded (single aeration): 0.60 ($kgCH_4$/ha/day);

(ii) Scenario 2: Change to intermittent flooded (multiple aeration): 0.72 ($kgCH_4$/ha/day).

Option 1: Provide default values as specific baseline factors ($kgCH_4$/ha/day)

	EFc	*Baseline*			
		SFw	*SFp*	*SFo*	*Emission Factor*
For regions/countries where double cropping is practiced	1.30	1.00	1.00	2.88	**3.74**
For regions/countries where single cropping is practiced	1.30	1.00	0.68	1.70	**1.50**

Option 2: Provide default values as specific emission reduction factors ($kgCH_4$/ha/day)

	EFc	*Baseline*				*Project Scenarios*	*Project*				*Emission Reduction Factor*
		SFw	*SFp*	*SFo*	*Emission Factor*		*SFw*	*SFp*	*SFo*	*Emission Factor*	
For regions/ countries where double cropping is practiced	1.30	1.00	1.00	2.88	**3.74**	**Scenario 1:** Change the water regime from continuously to intermittent flooded conditions (single aeration)	0.60	1.00	2.88	**2.24**	**1.50**
						Scenario 2: Change the water regime from continuously to intermittent flooded conditions (multiple aeration)	0.52	1.00	2.88	**1.95**	**1.80**
For regions/ countries where double cropping is practiced	1.30	1.00	0.68	1.70	**1.50**	**Scenario 1:** Change the water regime from continuously to intermittent flooded conditions (single aeration)	0.60	0.68	1.70	**0.90**	**0.60**
						Scenario 2: Change the water regime from continuously to intermittent flooded conditions (multiple aeration)	0.52	0.68	1.70	**0.78**	**0.72**

20. The SSC WG agreed to request the Board to launch a call for public inputs on the proposed approaches for deriving specific default values for methane emissions in rice field. To this objective, the SSC WG is looking for feedback on:

(a) Are the proposed approaches for estimating the regional/country specific default values for methane emissions in rice field practical and appropriate? Which option should be selected? Only for the baseline scenario, or for both baseline and project scenarios? Are the values reasonable and conservative?

(b) In case Option 2 (i.e. default emission reduction factor) is selected, what kind of additional conditions or monitoring requirements if any should be included in the methodology to ensure that emission reductions are actually realized through the implementation of the project activity?

(c) Shall the cultivation period (days) be necessarily monitored, e.g. in logbooks? Is it possible to determine valid and conservative default values for the rice cultivation periods applicable for countries/regions or for certain and given conditions of cultivation practices?

(d) Possible default values for the amount of organic amendments other than rice straw (i.e. t/ha application of compost, farm yard manure or green manure);

(e) Are there other approaches for determining methane emission factor that should be assessed? If any, please provide further justification on the proposed approach(es).

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