MADD Ghana – Alternative Wetting and Drying for Rice Cultivation

General information

Transferring Country	*Ghana*
Mitigation Activity Name	*Promotion of climate smart agriculture practices for sustainable rice cultivation in Ghana*
Mitigation Activity Proponent	*United Nations Development Programme (UNDP)*
Sector	*Agriculture*
Summary	*The ITMO programme promotes the adoption of climate smart agriculture of which Alternate Wetting and Drying (AWD) for rice cultivation is a core component. The ITMO programme will provide targeted technical training to farmers. Ghana's rice farmers are used to flooding their rice field throughout the cropping season. This practice leads to significant methane emissions. Through the AWD application, rice farmers reduce methane emission and improve efficiency of water use without reducing their rice yields. AWD has been identified as an effective climate smart mitigation measure and reduces also inefficient water management in irrigated rice ecosystem as directly associated co-benefit. In the end, the ITMO programme is expected to:* • *Lead to the adoption AWD technology covering 78% per cent of Ghana's rice production areas in Ghana* • *Reduce 1,125,655 tCO_2eq*
Version of document	*6*
Date and place	*7th April 2022, New York*
Total number of ITMOs for transfer	*1,125,655 tCO_2eq until 2030*
Programme start date	*1st October 2022 (Onboarding of Farmers)*
Start date and end date of the crediting period	*1st October 2022 – 31st December 2030*

1 Executive Summary

Programme Description

The measures described in this ITMO mitigation activity design document are introduced for the agriculture sector – rice cultivation – that is extremely vulnerable to the impacts of climate change and commonly associated with food security. However, agriculture also contributes to more than 20 per cent of Ghana's methane emissions, according to Ghana's fourth inventory report (2019). Although rice cultivation occupies a top position among the sources of agricultural emissions, this emission source has not been addressed by any major climate change-related activities up to the present. Evidently Ghana's updated nationally determined contribution did not include specific mitigation commitment in the agriculture even though there are significant cost-effective emission reduction opportunities in the country. Since the ITMO programme is neither included in the conditional nor in the unconditional NDC, and therefore not considered in the NDC baseline, the ITMO programme is additional to Ghana's NDC and only possible through the cooperative approaches under Article 6.2 of the Paris Agreement.

Rice is an important food crop for Ghana, however, with current production deficits. The Government policy is to increase rice production to reduce the costs of imports. The adoption of climate-smart agricultural practices, including the System of Rice Intensification (SRI)[1] of which AWD is a core component, has been promoted by the Ghana CSIR-Crops Research Institute (CCSIR-CRI), who has the Government mandate to deliver sustainable water and nutrient management for rice, as a water savings technology. At the Kumasi test site, trials have been implemented and are shown to farmers, extension officers, irrigation management staff and policy actors to reduce the hesitance of applying AWD.

This programme will target a total of up to 20,500 ha per cropping season and in total 242,600 ha of irrigated rice fields over 8.25 years and 2 cropping seasons per year, approximately 78 per cent of the irrigated rice fields across the whole country. The introduction of AWD in these flooded, irrigated rice fields can bring in total approximately 1,125,655 tCO_2eq of emission reductions by 2030.

Awareness raising and technical trainings in addition to the provision of water level measuring tubes for farmers will be the core of the programme implementation as the way of promoting the adoption of climate smart agricultural, in particular SRI techniques. As the programme aims at changing an established cultural practice, in addition to the economic incentives, continuous trainings and guidance for farmers are crucial for the success of the programme and reaching its targets.

Towards the end of the programme implementation, it is expected that the targeted farmers will have adopted SRI and AWD as their standard irrigation practice. By that time, Ghana will have an increasingly resilient rice production sector capable of withstanding many of the challenges of climate change, thus guaranteeing the stable supply of a staple food for Ghana's population.

Why is the ITMO part crucial for the financial model?

The persistent barrier for the application of alternate water management is changing an established cultural practice. This requires financial incentives to increase farmers' confidence in the newly established climate smart agricultural practice. Once the cultivation practice is established, AWD will become self-sustaining as it doesn't have any negative impacts on rice yield but several positive impacts on pest and water management.

How does it contribute to sustainable development?

[1] *sri-waapp-book-single-p-8mb.pdf (wordpress.com)*

Ghana's NDC promotes mitigation co-benefits resulting from adaptation actions in the agricultural sector. This includes in particular the adoption of climate-smart agricultural practices such as the SRI to promote sustainable land management which leads to water savings.

Through the ITMO programme and the trainings delivered during its implementation, these objectives can be achieved. The programme has significant co-benefits related to sustainable land management and will be directly covering at least 10 Sustainable Development Goals.

The ITMO programme ensures environmental sustainability through improved soil quality (see page 6, technology description), and also contributes to the eradication of extreme poverty and hunger, by supporting farming communities through better management of nutrient, pest and improved water management and stable rice yields. The programme also widens the income source base through diversification of agricultural production enabled by higher water availability for other crops. The ITMO programme supports know-how transfer which can contribute to more sustainable growth in the agricultural sector. Finally, the programme creates new opportunities for farmers to generate income, as well as for trainers and qualified personnel involved in programme implementation.

At the end of this programme, it is expected that farmers will commonly practice AWD replacing continuous flooding, leading to a reduced carbon footprint in rice production. The results can be replicated across Ghana through strong and reinforced policy support. The ITMO programme envisions to transform the irrigated rice sector into a more resilient and sustainable rice production system in the face of climate change-induced threats and damages.

Is the activity covered by the unconditional NDC?
() yes (x) no

Does the activity receive international climate finance?
() yes (x) no

2 Background

Agriculture is one of the sectors with significant contribution to GHG emissions globally and is extremely vulnerable to the effects of climate change. In Ghana's inventory, rice cultivation accounts for 20 per cent of Ghana's methane emissions from the agricultural sector. There was an increase in areas of cultivation of rice from 88,300 ha in 1990 to 236,000 in 2016 according to the 4th National Communications. For these years, rice cultivated under low land areas with highest methane generation potential, formed the majority and followed by upland rice. In 2016, 3.29 $MtCO_2eq$ methane emissions were predominantly from the agriculture category; the rice sector contributed 23% of CH_4 emissions and emanated mainly from rice production.

However, agriculture is unique, as it is directly related to food security and the livelihood of a large number of farmers, thus calling for a holistic approach under any climate change-related initiatives. The complexity of the agricultural sector has been strongly reflected in the climate change and agriculture policy of Ghana. The Government of Ghana has been aiming to design holistic approaches that address food security, improved water management and water savings and poverty eradication and increasingly look at climate change-related issues. This resulted in the development of the ITMO programme which addresses climate change impacts of rice cultivation through target measures which also enhance the overall competitiveness of rice production and reflect the policy targets for the agricultural sector in Ghana.

The sector in Ghana is heavily dominated by individual landowners who manage small plots of land and follow a deeply entrenched and traditional cultivation practice, involving the continuous flooding of rice fields up to harvest. There are no policies or economic incentives for farmers in Ghana to implement new or modified water management systems. Therefore, technical trainings for farmers will be at the core of the programme implementation as the programme aims at changing an established cultural practice. In addition to the economic incentives, continuous training and guidance for farmers are crucial for the success of the programme.

Paddy fields are considered an important anthropogenic source of atmospheric CH_4. The main vectors behind methane emissions from paddy rice fields are methanogenic (methane forming) bacteria (Epule, 2011)[2]. The bacteria perform well under anaerobic conditions, harvest organic carbon and transform it into methane through the process of methanogenesis (Bloom and Swisher, 2010). Anaerobic conditions are the biochemical pathways of methane production (Epule, 2011). Methane is vertically transported to the atmosphere through three main pathways. These pathways include a) diffusion of dissolved methane, b) the emergence of bubbles triggered by soil fauna and crop management procedures, and c) plant transport by diffusion into the roots and conversion to gaseous methane in the cortex and aerenchyma, and subsequent release of methane to the atmosphere through plant micropores (Wassmann, Papen and Rennenburg, 1993)[3].

AWD is a water management technology that uses a simple tool to guide the farmer in determining the right time to irrigate and the right amount of water to apply. Under AWD water saving conditions, methane emissions are likely to be reduced by more than 30 per cent. Generally, AWD is an effective and efficient climate change mitigation technology which not only improves rice production and helps conserve a limited resource, water, but also mitigates rice paddies' contribution to global

[2] *Epule, Terence E. (2011). Methane Emissions from Paddy Rice Fields: Strategies towards Achieving A Win-Win Sustainability Scenario between Rice Production and Methane Emission Reduction. Journal of Sustainable Development, vol. 4, No. 6, pp. 188-196.*

[3] *Wassman, R., H. Papen and H. Rennenberg (1993). Methane Emission from Rice Paddies and Possible Mitigation Strategies, Chemosphere, vol.26, Nos.1-4, pp.201-217*

warming (IRRI 2008). IRRI (2008) and Lampayan and others (2015)[4] reported that AWD as a water management strategy is widely used in China, and is rapidly being adopted in Vietnam, Bangladesh, Myanmar and Indonesia. However, the successful adoption of AWD in these countries is a consequence of massive awareness raising, capacity building and training programmes over a sustained period of time and targeted financial incentives funded by public and grant resources to achieve a lasting, transformational change. The "Meta-Impact-Assessment of the Irrigated Rice Research Consortium, Special IRRI report[5] demonstrates this well. In Ghana, AWD as part of SRI techniques has not been introduced at scale and the validation and promotion of AWD is therefore not business as usual yet. The promotion of AWD has begun only in 2020 through the national agricultural research and extension systems and their partners (http://recirculate.global/2020/03/disseminating-awd-to-rice-farmers-in-ghana/).

The demonstration trials in Kumasi are successful. However, no financial incentives exist for farmers to switch to SRI and especially AWD, making promotion of AWD extremely difficult without any further target measures. The ITMO programme runs for 8.25 years and will offer not only financial incentives but also targeted trainings and technical and scientific support throughout the lifetime of the programme. Farmers AWD application progress will be tracked throughout programme implementation and farmers will receive additional technical guidance as needed to continue the monitoring of the AWD application and apply corrective actions as needed beyond the ITMO project.

The programme targets farmers, who are members under the *Ghana Irrigation Development Authority Scheme* located in the service areas of Greater Accra, Volta, Central, Ashanti, Northern, Upper East and Upper West regions of Ghana. These regions are the seven major rice producing regions in the country. SRI, including AWD practice leads to a better management of nutrient, pest, and harvesting brought about by improved water management.

In terms of food security, it should be taken into consideration that research and trials in Ghana and beyond have demonstrated that AWD does not lead to decreases in yields, in particularly if implemented as part of SRI. Thus, the introduction of AWD is not expected to impact food security.

In order to achieve a wider transformational impact, as well as acceptance among farmers, the ITMO programme will offer a support package, consisting of trainings on SRI, in collaboration with the RICOWAS[6] project to participating farmers in scaling-up and diversifying climate resilient rice production. This will allow farmers who are interested to develop new agricultural skills and improve weed, pest and disease management and seed selection. Thus, the proposed ITMO programme will allow not only sizeable reductions of GHG emissions, but also the transformation of the rice sector by providing learning and knowledge-transfer over a sustained period of time.

Scope

The programme will be implemented in the seven major rice producing regions in the country:

(i) The service areas of Greater Accra,
(ii) Volta region,
(iii) Central region,
(iv) Ashanti region,
(v) Northern region,
(vi) Upper East and

[4] *Lampayan R.M., R.M. Rejesus, G.R. Singleton and B.A.M. Bouman (2015). Adoption and economics of alternate wetting and drying water management for irrigated lowland rice. Field Crops Research, No. 170, pp. 95-108.*
[5] *9789712202971_content.pdf (irri.org)*
[6] *Scaling-up climate-resilient rice production in West Africa (Benin, Burkina Faso, Côte d'Ivoire, Gambia (Republic of the), Ghana, Guinea, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo) - Adaptation Fund (adaptation-fund.org)*

(vii) Upper West regions of Ghana

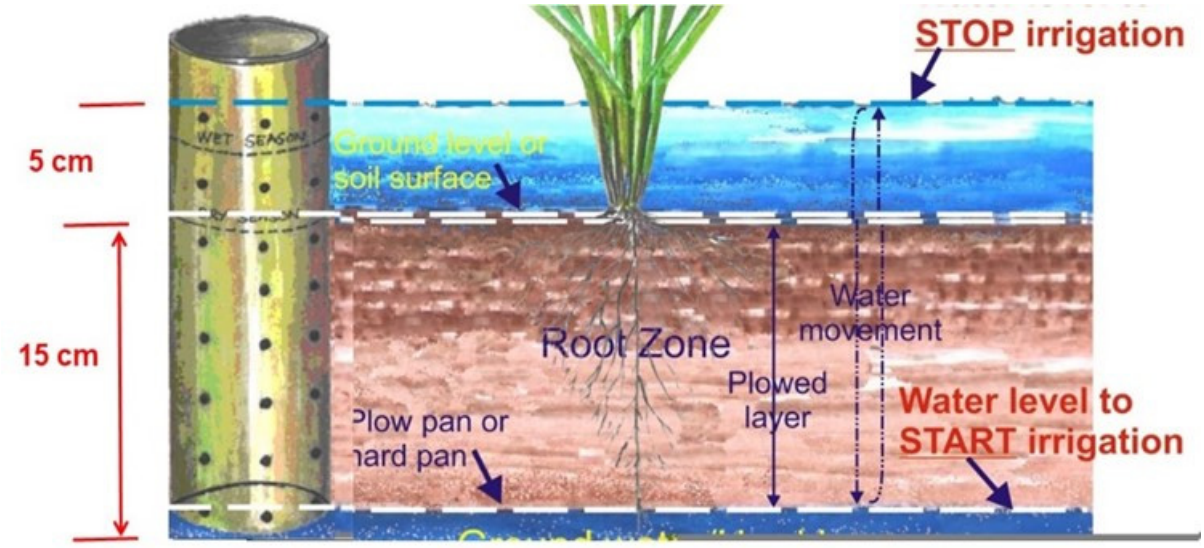
The ITMO programme will target the following rice production areas of Ghana, covering a total of up to 20,500 ha per cropping season. The ITMO programme will be implemented through 2 cropping seasons annually and the ITMO programme will be rolled-out over 3 years, starting in the first cropping season 2022 and with an expected full roll-out in 2026 and generate mitigation outcomes until 31st December 2030.

Double counting will be avoided through the commitment of the Ghana Government to apply a corresponding adjustment to all ITMO programmes and projects implemented under the bilateral agreement with Switzerland, including the ITMO programme "Promotion of climate smart agriculture practices for sustainable rice cultivation in Ghana". The corresponding adjustment will ensure that the Mitigation Outcomes are not claimed twice.

Technology

A simple tool used for AWD applications is a perforated 10 cm x 25 cm polyvinyl chloride (PVC) tube (an observation well) that is inserted 15 cm to 20 cm into the soil stratum. Irrigation water to a depth of 5 cm above the soil surface is applied and allowed to recede. Irrigation water is again applied when there is no more water inside the PVC tube. The AWD method is implemented at about 20 days after transplanting or sowing for direct seeded rice. However, during fertilizer application and panicle initiation to flowering, sufficient water must be available to maintain its level at 3-5 cm. When AWD is applied, the number of irrigation events in a season can range from four to six times only without leading to any yield loss and can result in significant adaptation and sustainability improvements.. Other benefits of AWD include the promotion of higher zinc availability in soil and improved aeration of soil, increased lodging resistance due to better root anchorage, reduction in pest infestation, such as golden apple snails, improved equity, and reduced upstream-downstream conflicts in canal irrigation systems.[7]

Figure 1: Perforated tube for monitoring the "hidden water" in the root zone



[7] [(PDF) Zinc Availability and Dynamics in the Transition from Flooded to Aerobic Rice Cultivation (researchgate.net)]

Participants

The overall goal of the ITMO programme is to empower Ghana's rice farmers.

There is concrete policy alignment of this ITMO programme with policies and strategies such as the *Agenda For Transforming Ghana's Agriculture (Investing for Food and Jobs*) as well as the Nationally Determined Contribution *Investing For Food and Jobs.*

The owner of the mitigation activity is the Ministry of Environment. The EPA under the Ministry of Environment is responsible for the coordination of the rice ITMO programme in Ghana and for ITMO reporting to UNFCCC.

The implementation of the ITMO programme will be monitored by the EPA. Guidance will be provided by the EPA to the farmers associations and to CCSIR-CRI regarding rules and procedures for MRV, while the Ministry of Food and Agriculture (MOFA) will monitor the rate of adoption of AWD. EPA will manage the MRV system for the ITMO programme. It will also be responsible managing the entire ITMO development process for the programme.

UNDP will oversee the day-to-day management of the ITMO programme, which will be implemented in close coordination with EPA and the different farmers associations. MOFA and the farmers associations will be supervising AWD applications and the execution of MRV practices.

MOFA will facilitate the adoption and training of the agronomic aspects of the AWD together with the rice associations and CSIR-CRI, who will deliver the training under the ITMO programme. After the onboarding of the first farmers through EPA extension officers during October 2022, the first training of trainers will be conducted on AWD and SRI principles by irrigation scheme managers, EPA regional and zonal staff, the associations and international carbon finance experts on 27th October 2022. The training will follow existing manuals/guidance provided by CSIR-CRI for their trials in Kumasi.

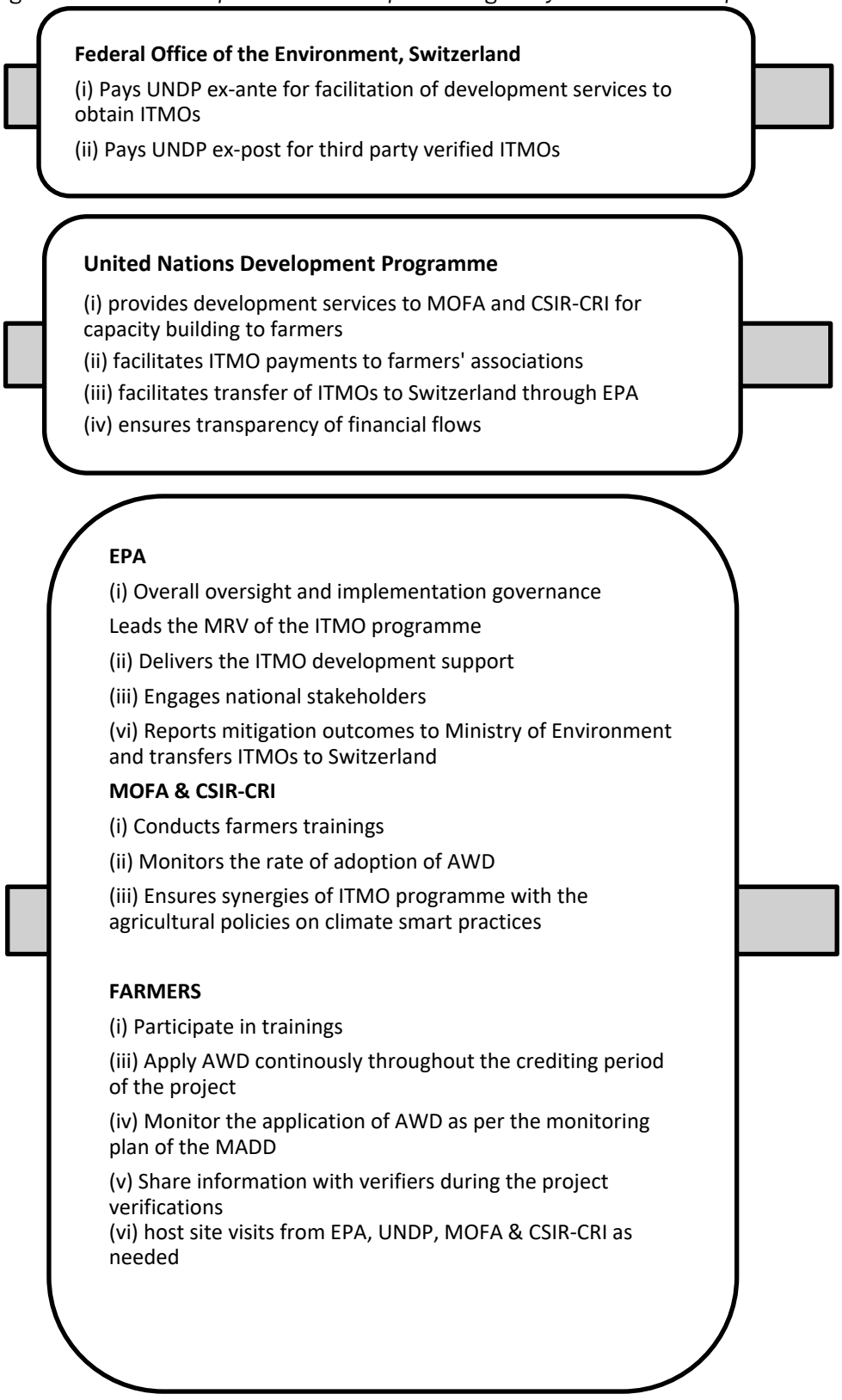
After the training of trainers, the trainings will be rolled out, starting on 31st October and implemented by the trained trainers in each irrigation scheme in the target regions in groups of up to 50 participants and led by EPA regional and zonal staff, overseeing each of the target regions. Farmers will also be trained on the Webapp for monitoring and will be handed-out a stepwise explanation of the technical implementation approach and monitoring requirements to access the carbon incentives. During the cropping seasons, the farmers associations will work with farmers and provide on-the-spot practical guidance on adopting AWD and SRI.

MOFA will ensure that the ITMO programme achieves synergies with the agricultural policies on climate smart practices and in particular on SRI practices and the RICOWAS project. The farmers associations will play a central role in the execution of the ITMO programme on the ground and will provide continuous hands-on support during implementation, track the application of AWD and report the implementation rate. Furthermore, the farmers associations will facilitate continuous trainings and targeted technical implementation support of their members through CCSIR-CRI. In this way, the farmers associations will become the engine for the dissemination of climate smart practices, as all farmers are part of associations and will benefit from the overall support their associations provide.

Since the ITMO generation is happening at the farm levels and by farmers, the legal ownership of the ITMOs generated from the activities lies with the farmers. However, the ownership will be transferred by the farmers to the EPA with the acceptance of farmers to participate in the ITMO programme and benefitting from the technical and financial incentives which will be provided upon the third-party verification of the mitigation outcomes achieved through the application of AWD. Rigorous monitoring will enable the tracking and verification of these results.

Below is a schematic overview of the institutional set-up, contractual arrangements and financial flows for the ITMO programme, through which the core entities and their critical roles can be identified:

Figure 2: Roles and responsibilities of implementing entity and bilateral cooperation countries



3 Baseline Setting

The baseline scenario of the ITMO programme is the hypothetical scenario describing what will happen in the absence of the proposed ITMO programme. As targeted technical and financial incentives to stimulate the application of AWD have not yet been implemented, the baseline scenario assumes the continuation of the current practice in rice cultivation. In Ghana, the current common practice of rice cultivation is continuous flooding of rice fields up to two weeks before harvest in the water management areas and the effects associated with that. AWD is not common practice in Ghana and apart from existing trials and small pilots promoted since 2020, not applied by rice farmers. The extent of penetration of the AWD and other climate smart technology among the rice farmers in Ghana will be assessed at the end of the current crediting period of the programme and Ghana's NDC baseline can be adjusted accordingly based on the results obtained at the end of the current crediting period of this programme.

The ITMO programme baseline scenario consists of two components, a GHG baseline and a Sustainable Development (SD) baseline. Setting the baseline scenario in this way allows the effects of the ITMO programme impacts to be properly assessed and quantified through the monitoring activities described in the MRV system.

The **GHG baseline** assumes the continuation of current rice cultivation practices in irrigated rice fields in Ghana, i.e., the continuous flooding of rice fields up to two weeks before harvest. These cover the emissions from the existing irrigated rice fields during the cropping seasons where double cropping is practiced. As per Ghana's inventory, the total national actual emissions from rice cultivation were 650,000 tCO_2eq in year 2019.

Until 31st December 2025, Option 1 of CDM methodology AMS-III.AU, version 4 will be applied, using the IPCC tier 1 approach to determine the baseline and project emissions. From the first cropping season of 2026 onwards, methane measurements will be conducted using the reference field approach.

The following formula has been applied:

Baseline Emissions:

$$BE_y = \sum_s BE_s$$ (Equation 1 of CDM methodology)

$$BE_s = \sum_{g=1}^{G} EF_{BL,s,g} \; X \; A_{s,g} \; X \; 10^{-3} \; X \; GWP_{CH4}$$ (Equation 2 of CDM methodology)

BE_y = Baseline emissions in year *y* (t CO_2e)

BE_s = Baseline emissions from project fields in season *s* (t CO_2e)

$EF_{BL,s,g}$ = Baseline emission factor of group *g* in season *s* ($kgCH_4$/ha per season)

$A_{s,g}$ = Area of project fields of group *g* in season *s* (ha)

GWP_{CH4} = Global warming potential of CH_4 (t CO_2e/t CH_4)

g = Group *g*, covers all project fields with the same cultivation pattern (*G* = total number of groups)

Baseline Emission Factor is further determined as:

$$EF_{BL} = EF_{BL,c} \; X \; SF_{BL,w} \; X \; SF_{BL,p} \; X \; SF_{BL,o}$$ (Equation 8 of CDM methodology)

EF_{BL} = Baseline emission factor ($kgCH_4$/ha/season)

$EF_{BL,c}$ = Baseline emission factor for continuously flooded fields without organic amendments ($kgCH_4$/ha/season)

$SF_{BL,w}$ = Baseline scaling factors to account for the differences in water regime during the cultivation period

$SF_{BL,p}$ = Baseline scaling factors to account for the differences in water regime in the pre-season before the cultivation period

$SF_{BL,o}$ = Baseline scaling factors should vary for both type and amount of organic amendment applied

In the absence of a seasonally measured emission factors until December 2025, the ITMO programme default emission factors, and emission reduction factors were applied as per the following table:

Table 1. Specific emission factors for baseline, programme and emission reductions (kgCH4/ha/day)*

		Baseline					Project				Emission
	EF_c	$SF_{BL,w}$	$SF_{BL,p}$	$SF_{BL,o}$	Emission Factor (EF_{BL})	Project Scenarios	$SF_{P,w}$	$SF_{P,p}$	$SF_{P,o}$	Emission Factor (EF_P)	Reduction Factor (EF_{ER})
For regions where double cropping is practiced	1.19	1.00	1.00	2.88	3.43	Scenario 1: change the water regime from continuously to intermittent flooded conditions (single aeration)	0.60	1.00	2.88	2.06	1.37
						Scenario 2: change the water regime from continuously to intermittent flooded conditions (multiple aeration)	0.52	1.00	2.88	1.79	1.64
For regions where single cropping is practiced	1.19	1.00	0.68	1.70	1.38	Scenario 1: change the water regime from continuously to intermittent flooded conditions (single aeration)	0.60	0.68	1.70	0.82	0.55
						Scenario 2: change the water regime from continuously to intermittent flooded conditions (multiple aeration)	0.52	0.68	1.70	0.71	0.65

The ITMO programme full crediting period is 8.25 years from October 2022 to December 2030. The start date is October 2022 with a full roll out throughout 2026. The individual, aggregated programmes will generate emission reductions throughout the 8.25 years of the crediting period.

The default values in the calculation for cultivation patterns are based on the grouping of fields by cultivation patterns as per Table 2 below.

Table 2: Definition of cultivation patterns in the baseline

Nr.	Parameter	Type	Values/Categories	Source/Method
1	Water regime on-season	Dynamic	Continuously flooded Single Drainage	Ministry of Agriculture information
2	Water regime pre-season	Dynamic	Flooded Short drainage	Ministry of Agriculture information
3	Organic Amendment	Static	No organic amendments	Ministry of Agriculture information
4	Number of cropping seasons	Static	2 (two)	Ministry of Agriculture information
5	Cultivation period of rice per year in days	Static	135	Ministry of Agriculture information

4 Promoting sustainable development

The **Sustainable Development baseline** is the continuation of non-resilient rice production, characterized by unsustainable water and land usage, a sub-optimal rice yield and use of rice production technology that does not apply state-of-the-art climate smart agricultural techniques. The SD baseline is characterized by various indicators related to the environment, social, growth and development, and economic domains. Wherever possible, the parameters are quantified, otherwise qualitative description will be provided.

The proposed ITMO programme will undergo a UNDP's SDG Impact Assessment through the Climate Action Impact Tool[8] (CAIT). The assessment under the CAIT Tool requires a thorough screening for potential negative impacts before assessing the programmes positive impacts. During this screening, risks are identified, and commensurate management approaches defined. The section "Social and Environmental Risk Screening" is compliant with UNDP's social and environmental screening procedures. The impact and probability of an event occurring will need to be graded from 1 to 5 with 1 being low (e.g., low level of impact or low probability of event occurring) and with the level of significance automatically calculated. Only those indicators that are defined as significantly high will need to be provided with additional information on a proposed risk mitigation approach.

During the ITMO programme preparation phase, UNDP together with the government and farmers association and other implementing partners will invite key stakeholders for an introduction presentation and actively seek their comments. The aim of this consultation process is to inform stakeholders about the ITMO programme and give them the opportunity to discuss the impact the programme will have on them.

Stakeholders will also have the opportunity to express concerns and for the implementing partners to address them. Further the stakeholders will be invited to review the documentation before submission for approval to ensure that all concerns expressed during the consultation were addressed in the final ITMO programme.

The CAIT, which will be applied to identify the significant sustainable development impacts, focusing on consolidating the direct impacts resulting from the programme. The tool provides the flexibility to define which impact can be considered significant and direct – and the outcomes (short-term or long term, intended or unintended) of the proposed ITMO programme.

The proposed ITMO programme will directly and positively impact at least 10 SDGs, summarized in the table below:

[8] *https://climateimpact.undp.org/#!/*

Table 3: Overview of ITMO programme SDG impacts

	*SDG1 – Generate stable income through sustainable rice production*
	*SDG2 - support farming communities in producing climate smart rice cultivation and sustainable irrigation methods, and enhancing knowledge about agricultural production*
	*SDG4 – contribute to inclusive and equitable education by providing targeted trainings and knowhow transfer of AWD and SRI to farmers*
	*SDG5 – help advance on gender equality by ensuring a minimum participation of female farmers in the trainings*
	*SDG6 – through sustainable water management practices in rice cultivation water is efficiently used, resulting in stable water supply*
	SDG8 – *create new job opportunities for farmers as well as for trainers and qualified personnel involved in ITMO programme implementation*
	*SDG9 - enable access to climate smart agricultural methods, resulting in more sustainable agricultural production through tech innovations*
	*SDG13 - fight climate change by avoiding CH4 emissions from continuously flooded paddies*
	*SDG15 – improve quality of soil through periodic aeration of the soil, resulting in higher zinc availability as well as increased plant root anchorage and lodging resistance*
	*SDG17 - technology and know-how transfer which contribute to a more sustainable agricultural sector.*

The following 3 SDG targets have been quantified and will be monitored during implementation.

These benefits are assuming the programme reaches full scale. Else the numbers are proptional to the share of ITMOs actually generated.

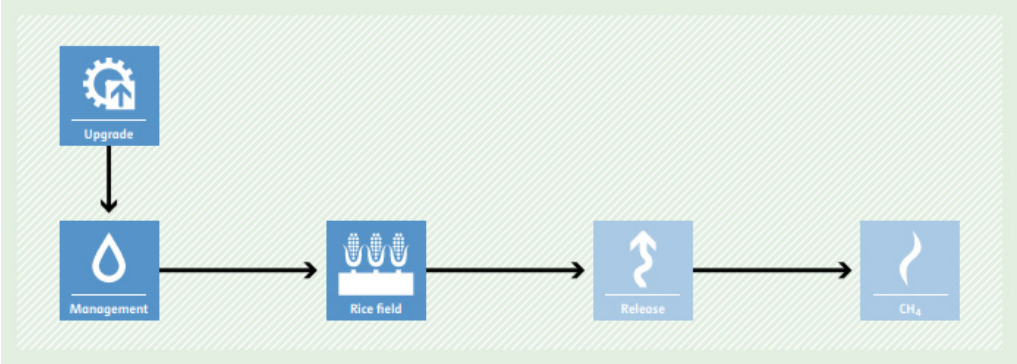
- SDG4: Contribute to inclusive and equitable education by providing targeted trainings to at least 100 farmers by offering inclusive trainings continuously during programme implementation.
- SDG5: Help advance on gender equality by ensuring a minimum participation of at least 30 female farmers in the trainings. Female farmers will be explicitly encouraged through invitations to participate in the trainings.

- **SDG6:** Application of AWD improves sustainable water management over the target programme area of 14,000 in each cropping season because the water consumption for rice cultivation will be reduced to less irrigation events.

5 Determination, monitoring and reporting of mitigation outcomes

The programme scenario is the roll out of climate smart agricultural practices to avoid CH4 emissions by changing the water regime during the cultivation period from continuously to intermittent flooded conditions and/or a shortened period of flooded conditions.

Figure 3: The programme scenario for the ITMO programme



Under the CDM methodology AMS-III.AU "*Methane emission reduction by adjusted water management practice in rice cultivation*", default values are used, including the baseline emission factor (EFBL,c) of 1.19 kg CH4/ha/day (IPCC 2019/refinement value).

The small-scale CDM methodology allows for the application of default values. These default values will be applied in the first 3 years because of the complexity of baseline measurements and significant costs involved in continuous methane measurements. While the overall programme is larger than the allowed threshold of a small-scale methodology, the individual more than 100 participating farmers are significantly below the threshold for small-scale programmes and are considered component programme activities under the overall programme.

The following inclusion criteria are conditional for the onboarding process of each component programme activity to the ITMO programme:

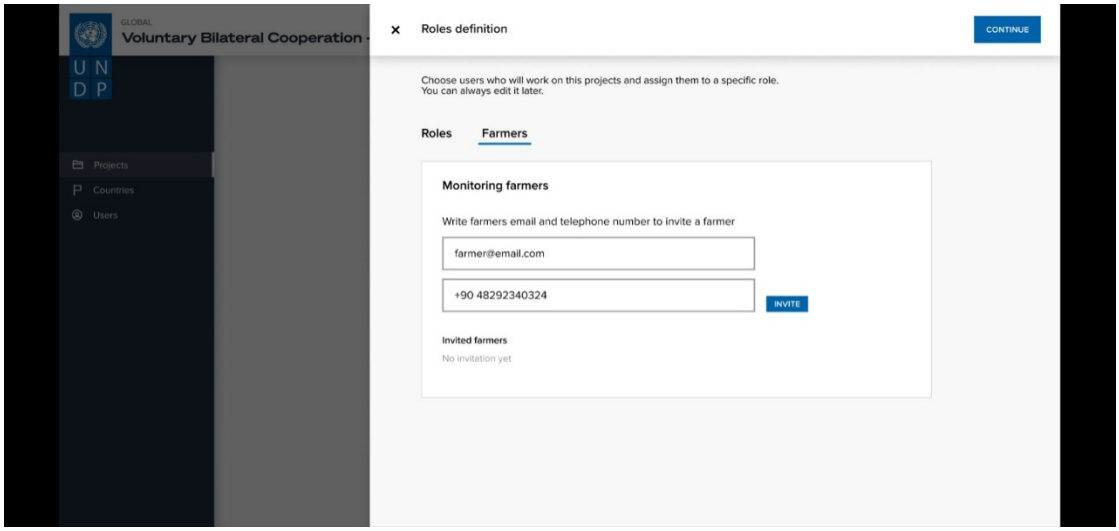
(a) The rice farms are characterized by irrigated, flooded fields for an extended period of time during the cropping season.
At the time of onboarding the farmers will confirm with their signature that their fields are irrigated and flooded over a period of time in the baseline (pre-project scenario). Extension officers of the Ministry of Agriculture, officers of the Environmental Protection Agency and UNDP have visited farms during the project preparation phase and have verified the baseline situation of farmers.
During the onboarding, farmers get access to the Webapp on the Platform for Voluntary Bilateral Cooperation[9] as shown in Screenshot 1 (mock-up view of the Webapp). The phone number of each farmer will be added to allow for a future inclusion of Azure Communication Services, initiating reminder calls to farmers for upcoming irrigation events.

The Platform for Voluntary Bilateral Cooperation is hosted by UNDP and made available to host countries such as Ghana to manage the ITMO workflow from project development to request for

[9] *Platform for voluntary bilateral cooperation (1.azurestaticapps.net)*

issuance. These ITMO process flow is managed by each country in a secure, private space which is only accessible upon invitation by the host country administrator.

Screenshot 1: Onboarding of Farmers



(b) Farmers are not required to switch to a cultivar that has not been grown by them before. This has been explained to farmers at the time of onboarding.

(c) Farmers have access to training and technical support during the cropping season that delivers appropriate knowledge in irrigation, drainage and use of fertilizer. This has been explained during onboarding and is supported throughout implementation through the trainings provided under the programme. The inclusion of farmers in the future will require them to confirm with their signature that their fields are irrigated and flooded over a period of time in the baseline (pre-project scenario). Extension officers will confirm by countersigning that the applying farm is a conventional rice farm.

For the purpose of GHG emission reduction estimations, it is assumed that the roll-out of the AWD application will start during the last cropping season in 2022 and the full roll-out will be achieved in 2026. Based on this assumption, the total emission reductions over an 8.25 years' period will be around 1,125,655 tCO2eq.

Project Emissions

Project emissions consist of the CH4 emissions, which will still be emitted under the changed cultivation practice. Due to the optimized N fertilization practice (N fertilizer control)[10], N2O emissions from soils micro-organisms do not significantly deviate from the baseline emissions and hence are not considered. As part of the scientific support during ITMO programme implementation, latest findings on GHG emissions from rice paddies will be shared and addressed as appropriate.

[10] *Kumar and Ladha. 2011. Direct seeding of rice: Recent developments and future research needs. Chapter 6. Advances in Agronomy, 11: 297-413. Vermeulen SJ, Campbell BM, Ingram JSI. 2012. Climate change and food systems. Annual Review of Environmental Resources 37: 195-222. Visalakshmi V, Rama Mohana Rao P, Hari Satyanarayana H. 2014. Impact of paddy cultivation systems on insect pest incidence. Journal of Crop & Weed 10: 139-142. Choi J, Kim G, Park W, Shin M, Choi Y, Lee S, Lee D, Yun D. 2015. Effect of SRI methods on water use, NPS pollution discharge, and greenhouse gas emissions in Korean trials. Paddy & Water Environment 13: 205-213.*

$$PE_y = \sum_s PE_s$$ (Equation 3 of CDM methodology)

$$PE_s = \sum_{g=1}^{G} EF_{P,s,g} \; X \; A_{s,g} \; X \; 10^{-3} \; X \; GWP_{CH4}$$ (Equation 4 of CDM methodology)

PE_y = Baseline emissions in year *y* (t CO_2e)

PE_s = Baseline emissions from project fields in season *s* (t CO_2e)

$EF_{P,s,g}$ = Baseline emission factor of group *g* in season *s* ($kgCH_4$/ha per season)

$A_{s,g}$ = Area of project fields of group *g* in season *s* (ha)

GWP_{CH4} = Global warming potential of CH_4 (t CO_2e/t CH_4)

g = Group *g*, covers all project fields with the same cultivation pattern (*G* = total number of groups)

Project Emission Factor is further determined as:

$$EF_P = EF_{BL,c} \; X \; SF_{P,w} \; X \; SF_{P,p} \; X \; SF_{P,o}$$ (Equation 9 of CDM methodology)

EF_P = Project emission factor ($kgCH_4$/ha/season)

$EF_{BL,c}$ = Baseline emission factor for continuously flooded fields without organic amendments ($kgCH_4$/ha/season)

$SF_{P,w}$ = Project scaling factors to account for the differences in water regime during the cultivation period

$SF_{P,p}$ = Project scaling factors to account for the differences in water regime in the pre-season before the cultivation period

$SF_{P,o}$ = Project scaling factors should vary for both type and amount of organic amendment applied

The table below summarizes the default values in the project emission calculation for cultivation patterns based on the grouping of fields by cultivation patterns.

Table 4: Definition of cultivation patterns in the project scenario

Nr.	Parameter	Type	Values/Categories	Source/Method
1	Water regime on-season	Dynamic	Intermittent flooded conditions (multiple aeration)	Monitoring: Farmers web-app
2	Water regime pre-season	Dynamic	Intermittent flooded conditions (multiple aeration)	Monitoring: Farmers web-app
3	Organic Amendment	Static	No organic amendments	Monitoring: Farmers web-app
4	Number of cropping seasons	Static	2 (two)	Ministry of Agriculture information

5	Cultivation period of rice per year in days	Static	135	Ministry of Agriculture information

Emission Reductions

The Emission Reductions in year y were calculated using default values of adjusted daily emission factor EF_{ER} (kgCH4/ha/day) as per the following formular below, in line with Option 1 of the methodology:

$ER_s = BE_s - PE_s$ *(Equation 5 of CDM methodology)*

Where:

ER_s = *Emission reductions in season s (t $CO2_e$)*

$$ER_y = EF_{ER} \, X \, A_y \, X \, L_y \, X \, 10^{-3} \, X \, GWP_{CH4}$$ (Equation 6 of CDM methodology)

ER_y	=	Emission reductions in year y (t CO_2e)
EF_{ER}	=	Adjusted seasonal emission factor (kgCH_4/ha/season)
A_y	=	Area of project fields in year y (ha)
L_y	=	Cultivation period of rice in year y (days/year). This is not applicable when seasonal emission factor is determined
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

$$EF_{ER} = EF_{BL} - EF_P$$ (Equation 7 of CDM methodology)

EF_{ER}	=	Adjusted seasonal emission factor (kgCH_4/ha/season)
EF_{BL}	=	Baseline emission factor (kgCH_4/ha/season)[11]
EF_P	=	Project emission factor (kgCH_4/ha/season)[12]

Net Emission reductions due to Implementation of the programme:

$$ER_s = ER_y \, X \, 0.89$$

Where:

0.89 = conservative factor considering the uncertainty range of 30-50% (more than 30% but less than equal to 50%) i.e., for an uncertainty band of 40% (average value).

[11] *Determined as per equation 8 of CDM methodology*
[12] *Determined as per equation 9 of CDM methodology*

The emission reductions of the ITMO programme are summarized in table 5 below.

Table 5: The ITMO programme emission reductions over 8.25 years

Year	Baseline GHG emissions (tCO_2eq)	Project GHG emissions (tCO_2eq)	GHG emission reductions (tCO_2eq)	Conservative Factor[13]	Net GHG emission reductions (tCO_2eq)
2022	166,562	86,751	79,811	0.89	71,032
2023	333,124	173,502	159,622	0.89	142,063
2024	370,138	192,780	177,358	0.89	157,848
2025	370,138	192,780	177,358	0.89	157,848
2026	474,239	246,999	227,239	0.89	202,243
2027[14]	231,336	120,488	110,849	0.89	98,655
2028	231,336	120,488	110,849	0.89	98,655
2029	231,336	120,488	110,849	0.89	98,655
2030	231,336	120,488	110,849	0.89	98,655
TOTAL	**2,639,544**	**1,374,762**	**1,264,781**		1,125,655

As per the methodology, any effects of the ITMO programme activity on GHG emissions outside the project boundary are deemed to be negligible and do not have to be considered. There is no leakage expected through insufficient water availability as farmers in irrigated areas and along the irrigation channels are managing water levels in a manner that minimum water availability is guaranteed in order to cultivate rice traditionally through continuously flooded rice paddies.

The table below shows the hectare coverage of AWD during the two cropping seasons per year.

Table 6: Project area in ha in a given year with 2 cropping seasons

Year	Hectares
2022	28,800
2023	28,800
2024	32,000
2025	32,000
2026	41,000
2027	20,000
2028	20,000

[13] *considering the uncertainty range of 30-50% (more than 30% but less than equal to 50%) i.e., for an uncertainty band of 40% (average value)*

[14] *The annual delivery of ITMOs is based on and reflects contractually pre-agreed off-take values by FOEN.*

2029	20,000
2030	20,000

Monitoring & Reporting

The MRV of the ITMO programme is based on the CDM methodology AMS-III.AU. It provides the values of baseline emission factors for methane emissions from rice cultivation. Thus, it applies to programmes that aim to change the water regime from continuously to intermittently flooded conditions in irrigated rice fields – exactly the aim of AWD. The application of a conservativeness factor is sufficient basis to prove GHG reduction in rice cultivation and delivers a cost-effective solution for the first 3 years of implementation and until sufficient revenues are received to conduct field measurements. With the default values and conservativeness factor, in year 1 to 3, the program only needs to prove the adoption of AWD in a particular area as the basis for calculating emission reductions.

Most of the CDM methodologies apply conservative factors when using IPCC defaults and interchangeability of value for baseline and project should be chosen. Based on the above an uncertainty factor of 0.89[15] for project emissions considering the uncertainty range of 30-50% (more than 30% but less than equal to 50%) i.e., for an uncertainty band of 40% (average value) will be applied to calculate the net CO2 reductions due to the implementation of the programme.

Additionally, during implementation, scientific support will be provided in the form of methane measurements in the field, exchange with international and national rice research experts, literature review and contributions to ongoing studies where relevant to advance research on the impacts of rice cultivation on climate change. A key collaboration partner will be Cornell University16. Through the Department of Global Development, Climate-Resilient Farming Systems Program, Professor of Practice, Erika Styger will encourage and support coordination between the RICOWAS[17] project and the ITMO project by engaging with key stakeholders of both programmes. This will not only ensure synergies between these programmes but also increase the number of farmers with access to trainings on SRI[18]. SRI offers advantages over standalone application of AWD because it produces stronger plans which also withstand drought and storm conditions better. It is an agro-ecological and climate-smart rice production methodology and was developed in Madagascar in the 1980s. Since then, it has spread to about 20 million farmers in more than 60 countries. AWD is a core component of the SRI methodology but complemented by simple but critical plant management practices of planting young seedlings, widely spaced in organic matter enriched soils. This allows every single plant to fully develop to its biological potential and to develop a deep and proliferous root system and above-ground plants to produce a high number of tillers and panicles, requiring less agro-chemicals.

Through Cornell University, the ITMO programme will also exchange on new methane monitoring initiatives such as utilizing satellite imagery invented by CarbonFarm[19].

[15] *FCCC/SBSTA/2003/10/Add.2 (unfccc.int)*
[16] *Cornell University*
[17] *Scaling-up climate-resilient rice production in West Africa (Benin, Burkina Faso, Côte d'Ivoire, Gambia (Republic of the), Ghana, Guinea, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo) - Adaptation Fund (adaptation-fund.org)*
[18] *sri-waapp-book-single-p-8mb.pdf (wordpress.com)*
[19] *CarbonFarm - Get global warming below 1.5 °C. Protect nature*

In order to determine the AWD adoption area, data collection will be set-up as follows:

The monitoring approach of the ITMO programme follows the CDM methodology and applies IPCC default values for the baseline and programme emission factors until December 2025. For the quantification of GHG emission reductions the parameter to be monitored is the aggregated programme area in a given season in hectares. Only AWD compliant farms will be considered.

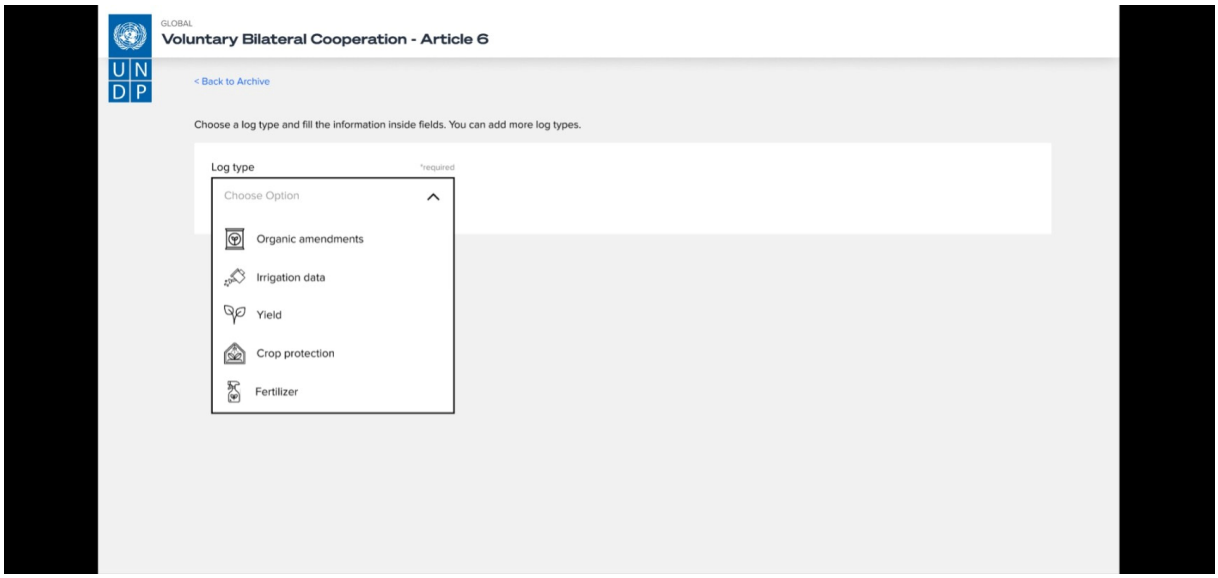
The aggregated programme area in ha will be determined by collecting the programme field sizes in a programme database.

In order to determine whether the participating rice fields are correctly applying AWD and can participate in the emission reduction calculations, the following protocol is proposed.

- A web-app will be used to document the following data:
- Total area planted (in ha);
- Sowing or transplanting (date);
- Fertilizer, organic amendments, rice straw management and crop protection application (date, quantity and active ingredients);
- Water regime on the field and in the rootzone (e.g., “dry/moist/flooded”) and dates where the water regime is changed from one status to another through the use of an observation well;
- Total number of irrigation events;

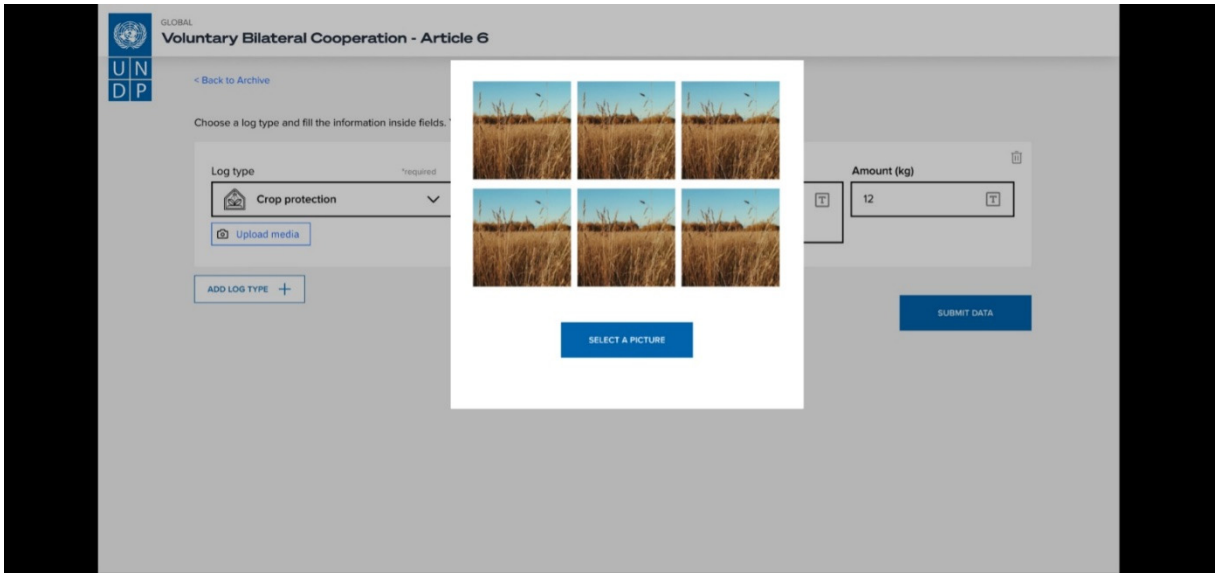
The monitoring parameters will be tracked through the Webapp as can be seen on Screenshot 2.

Screenshot 2: Monitoring of rice production events during a cropping season:



Plausibility checks are conducted by uploading pictures to the Webapp as shown in Screenshot 3:

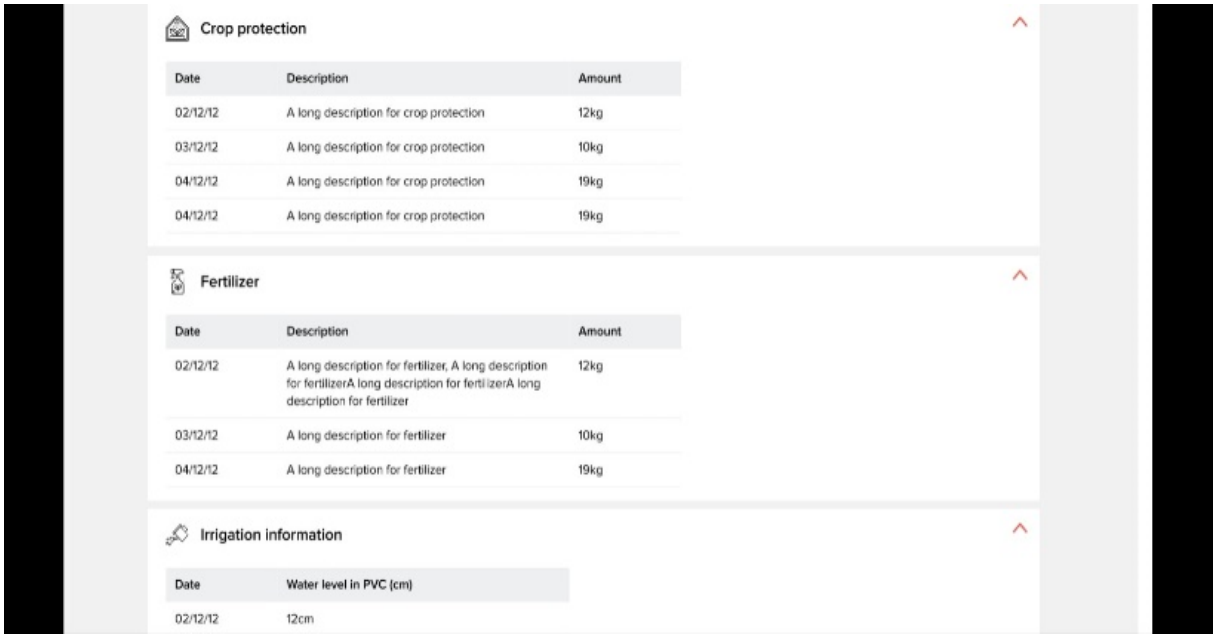
Screenshot 3: Selection and uploading of a monitoring picture



- Farmers must make a statement that they have followed fertilization recommendations provided by MOFA and CSIR-CRI which is tracked through the Webapp as can be seen in screenshots 2 and 3.
- It will be established that only those farms that comply with the programme cultivation practice are eligible.
- Participating farmers will also receive reminder calls from the monitoring platform to implement the required irrigation events in time.
- The webapp has been directly integrated into the platform for Voluntary Bilateral Cooperation[20] and all information uploaded via the webapp will be regularly checked by EPA's extension officers.
- The data submitted via the webapp will be directly fed into the monitoring section of the platform and will be accessible to the EPA, UNDP and the verifier, see screenshots 4 and 5. Each event submitted by a farmer will include the farmers name, the address and the plausibility confirmation through the uploaded photo.
- The EPA will publish the compliance data in the national statistics and provide additional support for this component of the MRV, if needed.

[20] *Platform for voluntary bilateral cooperation (1.azurestaticapps.net)*

Screenshots 4 & 5: Report archives for rice production events implemented during a cropping season



Crop protection

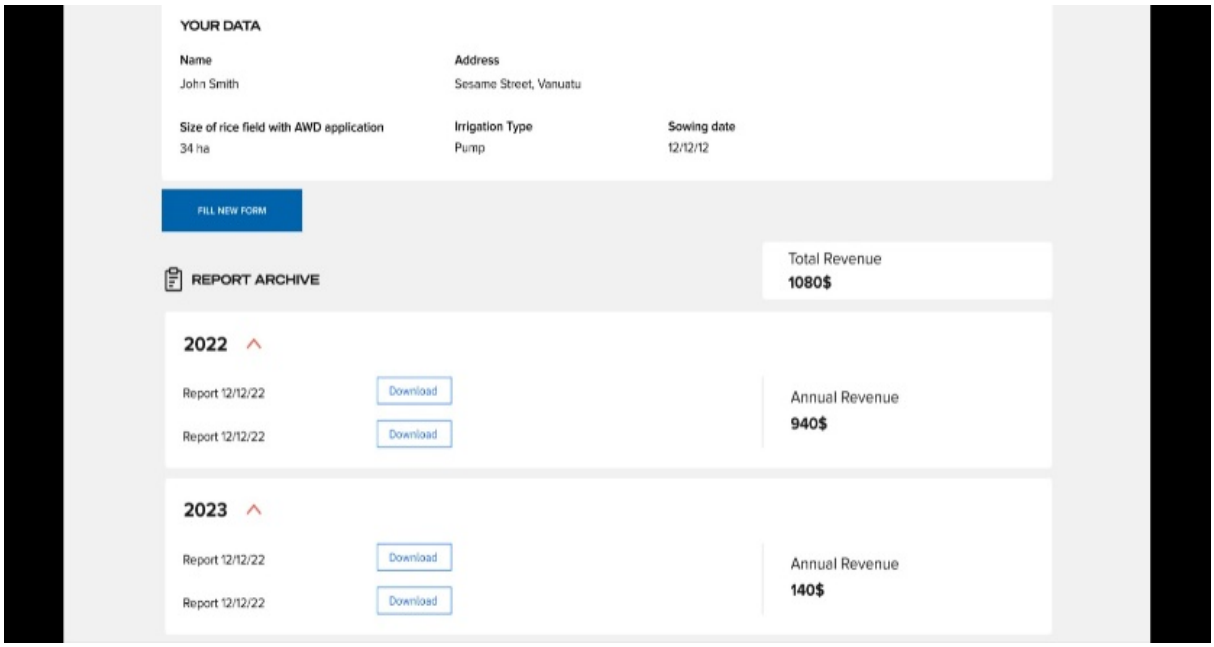
Date	Description	Amount
02/12/12	A long description for crop protection	12kg
03/12/12	A long description for crop protection	10kg
04/12/12	A long description for crop protection	19kg
04/12/12	A long description for crop protection	19kg

Fertilizer

Date	Description	Amount
02/12/12	A long description for fertilizer, A long description for fertilizerA long description for fertilizerA long description for fertilizer	12kg
03/12/12	A long description for fertilizer	10kg
04/12/12	A long description for fertilizer	19kg

Irrigation information

Date	Water level in PVC (cm)
02/12/12	12cm



YOUR DATA

Name
John Smith

Address
Sesame Street, Vanuatu

Size of rice field with AWD application
34 ha

Irrigation Type
Pump

Sowing date
12/12/12

FILL NEW FORM

REPORT ARCHIVE

Total Revenue
1080$

2022

Report 12/12/22 Download

Report 12/12/22 Download

Annual Revenue
940$

2023

Report 12/12/22 Download

Report 12/12/22 Download

Annual Revenue
140$

In addition to GHG emissions, the MRV system of the ITMO programme will cover sustainable development benefits. The monitoring parameters are summarized below

1. At least 100 farmers trained. The number of farmers trained, their names and email addresses will be recorded for each training event;
2. At least 30 female farmers trained. The number of female farmers trained, their names and email addresses will be recorded for each training event;
3. At least 14,000 ha with sustainable water management. The area over which AWD is applied will be recorded by the participating farmers and plausibility confirmed through photos and/or videos through the webapp.

Each monitoring report will also provide an update on the scientific support provided during each monitoring period and successful scientific collaboration events completed. This will include as appropriate and relevant: seasonal methane measurements, new scientific literature review, assessment of novel findings from the International Rice Research Institute, Cornell University, Agroscope[21] and other key research centers working on rice cultivation practices, featuring international and national agricultural experts' opinions on climate smart agriculture, SRI and AWD and where possible updates regarding collaboration and contributions from Cornell and the Ghana CSIR-CRI.

Methane measurements[22] will be conducted from the first cropping season in 2026 onwards, and continue for all cropping seasons until the end of the crediting period of the ITMO programme (31st December 2030). Methane measurements will follow the cropping season as per UNFCCC guidance in AMS-III.AU, Appendix *Guidelines for measuring methane emissions from rice fields* and latest national and international research. The measurements will be implemented in fields applying AWD and baseline reference fields in the project area. On these fields, measurements will be conducted with chambers, resulting in an emission factor expressed as kgCH4/ha per season. A seasonally integrated representative baseline emission factor EFBL,s,g will be derived as average value from the measurements for each group conducted during the cropping seasons of 2026, 2027, 2028, 2029 and 2030.

Through international support, knowledge transfer will be achieved, and in particle doctoral students from Ghana will be invited to participate in this research opportunity. The data obtained will contribute to additional scientific methane emission data from rice cultivation in Ghana and West Africa.

Data collection starts from the individual rice farmers who adopt AWD as their water management practice. Farmers will be introduced to the webapp during the onboarding and will use the webapp and submit information to the monitoring platform on a continuous basis. ITMOs shall be issued to the compliant farms for that particular season. The verified ITMOs will be used to support the claim for payment of the incentives of the farmers in that particular area.

Further, a robust MRV system is a key requirement under UNFCCC and the Paris Agreement. Ghana participates in existing MRV arrangements of the UNFCCC including preparation and submission of National GHG inventory reports, National Communications and Biennial Update Reports (BUR) as well international consultation and analysis processes. Further, under the PA commitments, Ghana participates in the enhanced transparency framework (ETF), which builds on the existing arrangements and will require to communicate the National GHG Inventory, National

[21] *Agrisource | Agroscope - Swiss Federal Research Institute*

[22] *CDM: Methane emission reduction by adjusted water management practice in rice cultivation --- Version 4.0 (unfccc.int)*

Communications, biennial transparency reports (BTR), progress on NDC implementation, adaptation communications and reporting on support (provided/received).

In order to meet its reporting requirements, Ghana has developed a national ITMO registry, a web-based programme and carbon accounting tool (deployed on a cloud server), designed specifically considering the domestic and international reporting requirements on climate actions. The web-based registry provides robustness and accessibility to the different user groups.

The users can access the national ITMO registry using any web-browser with their login credentials. The users of the online registry are the members of the national MRV team, or any other relevant team(s) assigned by the EPA.

Independent Plausibility Checks

The programme roll out will be documented by photo recordings by the farmers.

National MRV focal points

The following focal points in the Government are responsible for Mitigation Action Tracking and Reporting:

Daniel Tutu Benefoh	Environmental Protection Agency
Kingsley Amoako	Crop Services Directorate, Ministry of Food and Agriculture
Gyimah Mohammed	Ministry of Environment, Science, Technology and Innovation

Parameters fixed ex-ante and parameters monitored

The following parameters shall be fixed ex-ante as per the approved CDM methodology AMS-III.AU "*Methane emission reduction by adjusted water management practice in rice cultivation* for 2022, 2023, 2024 and 2025

Data / Parameter table 1.

Data / Parameter	$EF_{BL, s, g}$
Data unit:	kgCH4/ha/day
Data value	3.43
Description:	Baseline emission factor
Source of data:	IPCC 2019/refinement value
Measurement procedures (if any)	Not applicable
Purpose of data	Calculation of baselines emissions
Additional comments:	As per equation 2 of applied CDM methodology.

Data / Parameter table 2.

Data / Parameter	$EF_{P, s, g}$
Data unit:	kgCH4/ha/day
Data value	1.79
Description:	Project emission factor
Source of data:	IPCC 2019/refinement value
Measurement procedures (if any)	Not applicable
Purpose of data	Calculation of project emissions
Additional comments:	As per equation 4 of applied CDM methodology.

The following parameters shall be monitored as per the approved CDM methodology AMS-III.AU "*Methane emission reduction by adjusted water management practice in rice cultivation*.

Data / Parameter table 3.

Data / Parameter	**$A_{s,g}$**
Data unit:	ha
Description:	Aggregated project area in a given season s
Source of data:	webapp (see Screenshot 2)
Monitoring Frequency:	Every cropping season
Measurement procedures (if any)	To be determined every season by collecting the project field sizes in a project database through compilation webapp inputs.
Purpose of data	Calculation of baselines emissions
Additional comments:	As per equation 2 of applied CDM methodology.

Data / Parameter table 4.

Data / Parameter	**L_y**
Data unit:	Days/year
Description:	Cultivation period of rice per year
Source of data:	webapp (see Screenshot 1)
Measurement procedures (if any)	To be determined every season using webapp inputs.
Purpose of data	Calculation of Emission Reduction
Additional comments:	As per equation 6 of applied CDM methodology.

Data / Parameter table 5.

Data / Parameter	$Eligibility_F$
Description:	All data recorded through the webapp will be continuously reviewed by EPA extension officers and will be confirmed during site visits conducted on a monthly basis: (i) Total area planted (in ha); (ii) Sowing or transplanting (date); (iii) Fertilizer, organic amendments, rice straw management and crop protection application (date, quantity and active ingredients); (iv) Water regime on the field and in the rootzone (e.g. "dry/moist/flooded") and dates where the water regime is changed from one status to another through the use of an observation well;
Purpose of data	Plausibility checks
Source of data	Webapp

Data / Parameter table 6.

Data / Parameter	$EF_{BL, s, g}$
Data unit:	kgCH4/ha/day
Data value	-
Description:	Baseline emission factor, measured seasonally during the cropping seasons 2026 – 2030)
Source of data:	Webapp
Measurement procedures (if any)	As per CDM Methodology AMS-III.AU, version 4
Purpose of data	Calculation of baselines emissions
Additional comments:	As per equation 2 of applied CDM methodology.

Data / Parameter table 7.

Data / Parameter	$EF_{P,s,g}$
Data unit:	kgCH4/ha/day
Data value	- -
Description:	Project emission factor, measured seasonally during the cropping seasons 2026 - 2030
Source of data:	Webapp
Measurement procedures (if any)	As per CDM Methodology AMS-III.AU, version 4
Purpose of data	Calculation of project emissions
Additional comments:	As per equation 4 of applied CDM methodology.

6 Transformational change

The proposed ITMO programme will ensure the permanence of the transformational change by addressing the behavioral barriers that hinder a widespread adoption of climate smart agricultural practices. Technical trainings for farmers will be at the core of the programme implementation as the programme aims at changing an established cultural practice. In addition to the financial incentives, continuous trainings and guidance for farmers on AWD, SRI, sustainable irrigation practices and diversification of agricultural production, are crucial to achieve a wider transformational impact, as well as acceptance among farmers. The ITMO programme will offer an optional additional training on agricultural diversification for participating farmers. Thus, the proposed programme will allow not only sizeable reductions of GHG emissions, but also the transformation of the rice sector by providing more efficient irrigation solutions.

The ITMO programme will achieve transformational impact also through access to knowledge transfer with research centres and universities and synergies with the RICOWAS project, updated technical know-how, and technical skills by engaging both men and women farmers, especially those located in isolated places such as at the tail end of an irrigation system. It will promote better management of water conflicts among members of farmers associations through improved water management and equal access to water. Through the trainings, farmers in all ages such as the youth and the elderly have equal access to updated information, technical skills, and an opportunity for mechanization through the incentive mechanism of the programme. Increased application of AWD and SRI will also lead to greater resilience to climate variability and stable yields.

AWD applied and SRI trained through this ITMO programme will create jobs and bring several development benefits associated with economic development, significantly contributing to the SDGs and the Government development plans. Moreover, it directly contributes to Ghana's NDC target of achieving climate smart agriculture.

The ITMO programme is expected to deliver the following outputs:

a) AWD is practiced continuously in 78% per cent of Ghana's rice production areas (up to 20,500 ha);

b) A long-term modified irrigation schedule in the target areas;

c) At least 100 farmers in the programme target regions are trained on AWD and SRI, efficient irrigation solutions and increasing productivity;

d) 1,125,655 tCO_2eq reduced due to implementation of climate smart agricultural practices;

e) The webapp has been developed for the programme and can be utilized by the CSIR-CRI beyond the programme to track the progress of AWD application in the country.

In order to achieve a transformational impact, the financial incentive is considered crucial (a) as a basis for raising the resources needed to fund the equipment, knowledge exchange and transfer and trainings and (b) to provide a direct financial incentive to farmers to change practice. It is expected that, by the end of the Programme, farmers will commonly practice AWD and also increasingly SRI, replacing their previous practice of continuous flooding, und unsustainable crop production, leading to a reduced carbon footprint in rice production.

The results can be replicated across Ghana and will transform the irrigated rice sector into a more resilient and economically sustainable rice production, capable of withstanding the many challenges of climate change

Key ITMO programme focal points

1. To revise this Mitigation Activity Design Document:
   - *Climate Change Unit, Environmental Protection Agency (Daniel Benefoh, PhD)*
   - *United Nations Development Programme (Alexandra Soezer, PhD, HQ & Stephen Kansuk, CO)*

2. To request for Authorization/registration and creation of ITMO:
   - *Climate Change Unit, Environmental Protection Agency (Daniel Benefoh, PhD)*
   - *Compensation Unit, Federal Office for the Environment (Aric Gliesche, PhD)*

3. To communicate matters relating to the development and operation of the ITMO programme:
   - *Climate Change Unit, Environmental Protection Agency (Daniel Benefoh, PhD)*
   - *United Nations Development Programme (Alexandra Soezer, PhD, HQ & Stephen Kansuk, CO)*

Focal points for grievance mechanism

All stakeholders shall be engaged during the ITMO programme implementation and operations, including through a grievance mechanism and shall have the opportunity to confidentially submit complaints to the host/buying country.

The following focal points will address concerns raised:

Ghana:

Chief Director, Ministry of Environment, Science Technology and Innovation, Accra

Switzerland:

Eduard Medilanski, Policy Advisor, Compensation Office, Federal Office of the Environment, Switzerland

7 Carbon Revenues

Since the programme doesn't generate any revenues but requires a drastic change of an established cultural practice, financial incentives for farmers are needed to incentivize the switch to climate smart agricultural practices. The switch to the climate smart agriculture requires trainings of farmers, associations and extension officers on a regular basis to ensure that the changes become permanent and the programme transformational.

Through the ITMO programme, farmers will also be offered a voluntary opportunity to participate in an innovative area yield index insurance cover that insures farmers against a myriad of climate risks, including windstorm, frost, excessive rainfall, heatwave, hail, flood, drought, pest and diseases. The premium payments are not affordable for the majority of rice farmers in Ghana but through carbon finance, these premium payments will be covered, and farmers will be offered to voluntarily participate in an insurance product that can cover the most pressing climate risks these farmers face today. In order to increase the trust of farmers in insurance products and simplify the payment processes, a technology platform will be used to onboard farmers and make payouts. The platform will provide the necessary functionalities to automate the lifecycle of digital insurance policies from end-to-end based on blockchain technology and smart contracts. Through the platform, claims are triggered when yield level in a designated district falls to below 70% of a set benchmark. Sum insured is calculated based on expected value (price per metric tonne) of the rice harvest in each district. Claims triggers are determined at the end of season via crop cutting experiments. The smart technology will automatically compare that data with the agreed triggers of the insurance product and select the eligible farmers for payout. The system will also verify if the records of all farmers eligible for payout confirm compliance and correct implementation of AWD before any payments are released.

Carbon finance is essential for the realization of this ITMO programme which is made financeable thanks to carbon revenues that can be generated from the sale of ITMOs, resulting from reduced methane emissions from alternate wetting and drying adoption to Switzerland. The primary financial incentive provided by the programme is the payment for ITMOs delivered. This provides an opportunity to structure a viable programme with targeted trainings for farmers and direct financial incentives to farmers. Farmers will be guided to invest this resource on farm inputs, insurance and technologies that can further improve farm sustainability. Through this, individual farmers can economically benefit from adopting AWD directly and indirectly. This will also help address the sustainability of the adoption of climate smart agricultural practices beyond the lifetime of the ITMO programme.

The major risk faced under the programme in this context is a volumetric risk, which is the risk that farmers do not adopt AWD or that the adoption rate is not sufficient to cover the overall costs. However, this risk is mitigated through targeted incentive payments to farmers for the emission reductions achieved during the cropping seasons by applying alternate wetting and drying. The incentive payments to the participating farmers will promote collective and wider adoption. From the generated revenues 47% of the revenues will go to farmers through direct financial incentives, trainings, monitoring support and consultations. Farmers will be guided to invest this resource on farm inputs and technologies that can further improve sustainability. Access to continuous trainings will be conditioned on a continuous adoption of AWD as core component of SRI practices. Through this, individual farmers can economically benefit from adopting AWD directly and indirectly. This will also help address the sustainability of climate smart agricultural practices adoption beyond the life of the ITMO programme.

Carbon revenues are also used to coordinate the programme with more than 100 individual farmers involved. To streamline the monitoring of the many rice fields, a webapp will be provided to

farmers during the onboarding to simplify the submission of the relevant monitoring information by farmers and reduce farmers burden to participate in the programme. The web-app will also avoid data gaps and smoothen data collection by the EPA and the verification of the data by an independent verifier.

Furthermore, funds will be required for annual verifications and for programme management and administrative expenses by the Article 6 Office. The programme ITMO issuance cycle will be based on a 12-monthly verification period, therefore payments to farmers will continue at those intervals for the nine-year duration of the FOEN commitment. The revenue streams calculation has been reviewed by the validators and FOEN but contains confidential information which cannot be made public.

Annex:

Emission Reduction Calculation