



LOW-METHANE FORAGES



Applicability of Low Methane Forage systems into voluntary carbon markets standards

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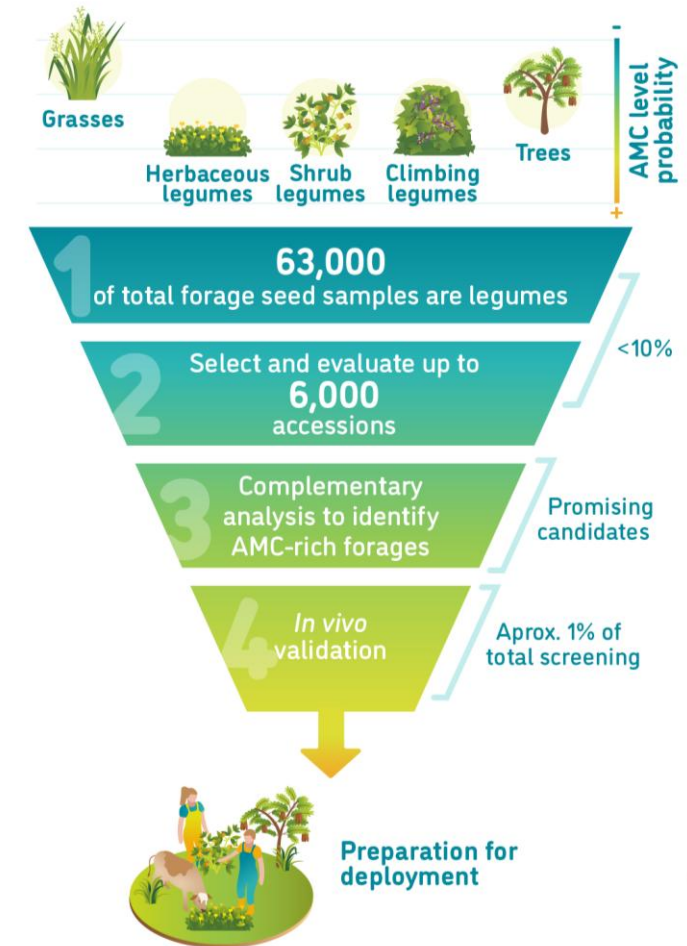
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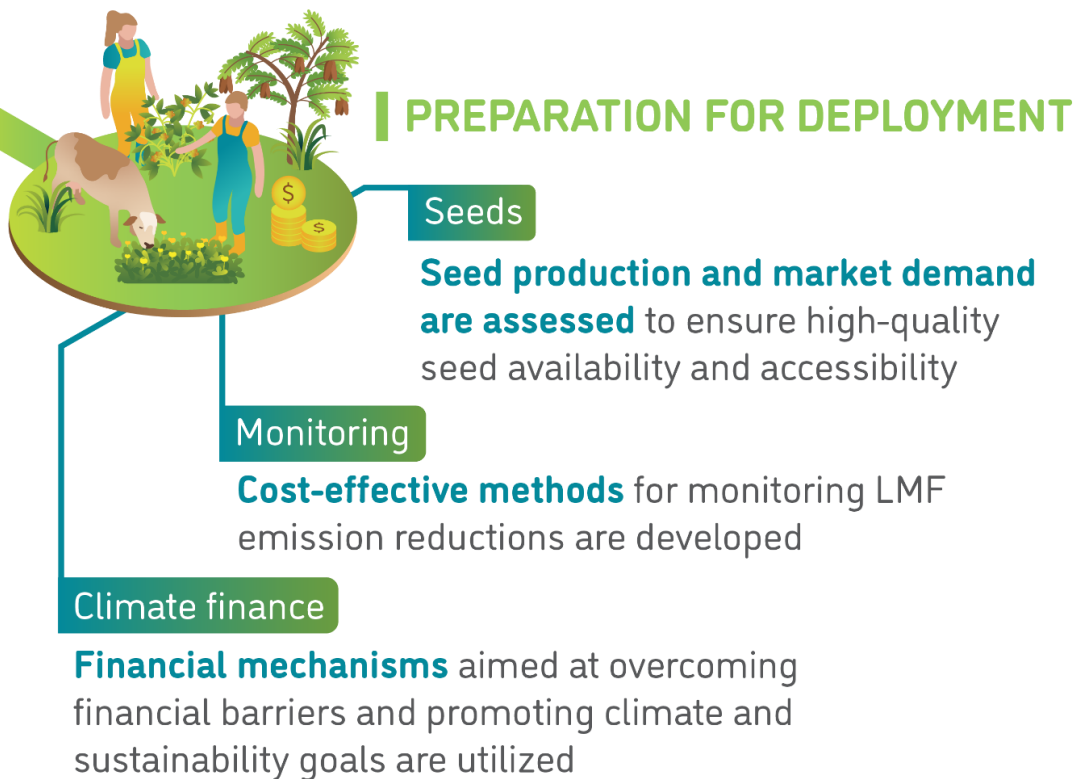


➤ Low Methane Forages (LMF) project

- **Low methane** tropical forages can reduce methane emissions by 15–30% without negatively affecting productivity (Arndt et al., 2022; Molina-Botero et al., 2024)
- LMF project identifies accessions from CGIAR gene banks
- High yield, nutritive, and drought-tolerant traits
- **Enteric methane emissions reduction**
- Deployment in the Global South



➤ Working package 3 of LMF



- Working package 3 of the LMF Project is preparing MRV options and methodological adjustments to scale the use of LMF in carbon projects
- **Scaling technologies is critical to achieving global food security and global climate targets!**

➤ The problem?

- Voluntary carbon market (VCM) is a financing mechanism to incentivize mitigation initiatives
- Opportunity to channel private finance into sustainable livestock production
- **No LMF-based carbon credit projects have been registered in LMICs, where forage-based systems are predominant**
- **Misalignment between carbon MRVs, national reporting systems, and climate finance requirements undermines investment and limits the scalability of LMF-based mitigation projects**
- **Finance exists, but methodologies don't match livestock systems**

➤ Objective

Address carbon market **gaps** by comparing leading methodologies

Assess if they work for Low methane Forages



- ✓ Compatibility with IPCC Tier 2
- ✓ Additionality
- ✓ Scalability

Materials and methods

1. Screening of VCM methodologies that capture methane emissions from enteric fermentation
2. Frameworks to address enteric methane mitigation in ruminants
3. Elements that determine the feasibility of LMF-based projects
4. Additionality
5. Baseline scenarios
6. Eligibility criteria
7. Structure and functionality of the MRV systems
8. Data collection protocols, quality control mechanisms
9. Methodological approaches used to monitor methane emissions

➤ Selected and compared methodologies

- VM0041 Verra's Verified Carbon Standard (VCS)
 - VM0042
-
- AMS-III.BK Clean Development Mechanism (CDM)
-
- GS Beef Gold Standard methodologies
 - GS Dairy

	VM0041	VM0042	AMS-III.BK.	GS Beef	GS Dairy	Pros	Cons
Scope in relation to methane emission	Methane reduction through feed additives	Emission reductions/removals from ALM practices Soil carbon storage Indirectly includes methane (modelling)	Reduce GHGs by improving dairy productivity through strategic feed supplementation	Methane reduction through feed additives	Reducing GHGs through improved feeding practices including the use of AMC-rich forages		
System assessed	Intensive livestock systems Dairy, non-dairy, sheep, goats, others	Variable intensity Dairy, non-dairy, sheep, goats, others	Smallholder dairy farms (≤ 100 animals). Dairy cattle	Semi-intensive to intensive beef production Beef cattle	Smallholder Dairy cows and buffaloes		
Interventions addressed	Feed supplements designed for enteric methane reduction	Improved grazing, crop, tillage/residue, or fertilizer management Not feed additive-focused	Productivity-enhancing supplements (not anti-methanogenic)	Feed additives reducing enteric methane (no carbon pool changes allowed)	Improved feeding, herd management, and milk yield		

Pros and Cons of MRV methodologies

	VM0041	VM0042	AMS-III.BK.	GS Beef	GS Dairy
Options for baseline enteric methane emissions quantification	<ol style="list-style-type: none"> Direct enteric methane measurements per animal group. IPCC Tier 2 method with specific dietary inputs IPCC Tier 1 default values (only for specified animal types) 	<ol style="list-style-type: none"> Project-specific EF from peer-reviewed literature Credible national/industry data sources Derived Tier 2 EF using project data (IPCC 2019) IPCC Tier 1/1a default EF (if insufficient data) 	<ol style="list-style-type: none"> IPCC Tier 2 energy balance equations based on herd-level data 	<ol style="list-style-type: none"> Direct enteric methane measurements IPCC Tier 2 modeling with feed, energy intake, population data, and methane conversion factor (Ym) 	<ol style="list-style-type: none"> GE intake calculated using full IPCC Tier 2 energy balance equations with detailed animal data GE intake estimated using DMI (simplified Tier 2 approach)
Options for project enteric methane emission quantification	<ol style="list-style-type: none"> Direct measurement of methane reduction factor Meta-analysis with ≥3 peer-reviewed studies 	<ol style="list-style-type: none"> Peer-reviewed research applicable to project IPCC Tier 2 modeling Default factors (Tier 1, IPCC 2019) 	<ol style="list-style-type: none"> Regression equation using milk productivity and additive data 	<ol style="list-style-type: none"> Direct measurement using tested tech with herd stratification. IPCC Tier 2 modeling of enteric fermentation 	<ol style="list-style-type: none"> Monitoring of emission intensity. Data collection on milk, feed, and herd metrics.
Variables needed to quantify enteric methane	Animal population by group, DMI, diet composition, GE intake, Ym, emission reduction factor	Same as IPCC Tier 2— animal population, DMI, GE intake, Ym Option for literature-based Efs	Herd-level data including milk yield, days in milk, DMI, GE intake, Ym	Animal stratification, DMI, GE intake, feed composition	Milk yield, DMI, herd composition, GE intake, simplified or full Tier 2 energy balance

 Pros
 Cons

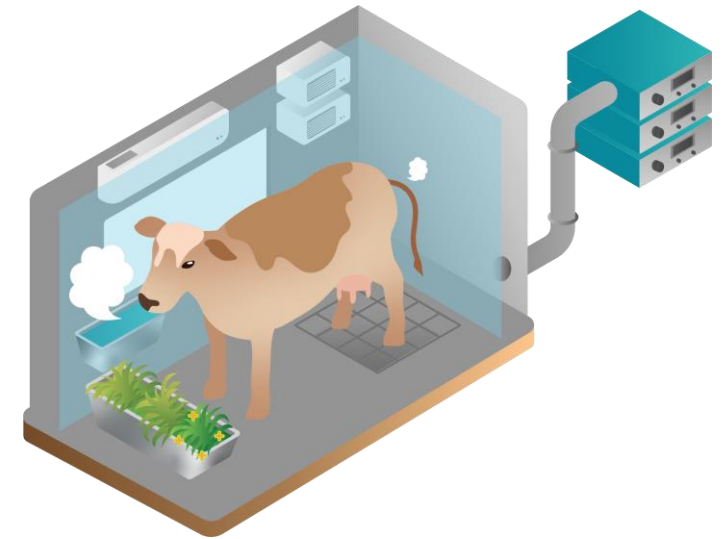
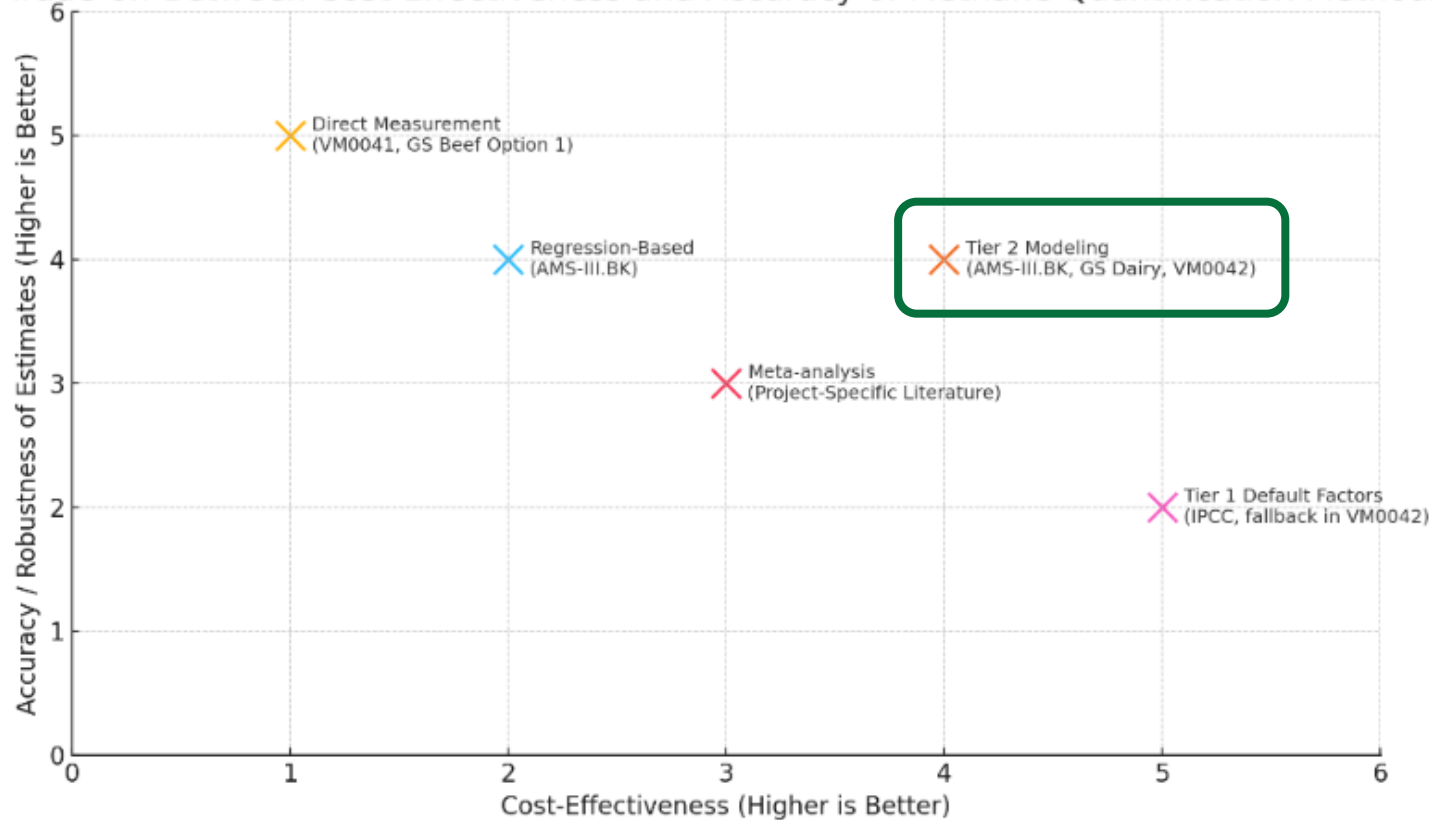
Pros and Cons of MRV methodologies

	VM0041	VM0042	AMS-III.BK.	GS Beef	GS Dairy
Additionality, attribution, and exclusivity	Non-common practice Additionality shown through deviation from norm				
Uncertainty	Conservative estimations of emission reductions				
Monitoring frequency	At least every 5 years		Annually or biannually		Regular monitoring; project= defined
Verification	Third-party verifiers accredited by the VCS				
Co-benefits	Enhanced livelihoods	Soil health, biodiversity, habitat, ecosystem resilience	Higher milk yields, income, and food security	Improved growth and profits	Improved livelihoods, milk yields, animal health

Pros and Cons of MRV methodologies

Approaches for monitoring enteric fermentation methane emissions

Trade-off Between Cost-Effectiveness and Accuracy of Methane Quantification Methods



➤ Take-home messages

- Scaling enteric methane mitigation in forage-based systems is critical
- LMF: biologically integrated, scalable solution
- Their inclusion in VCMs hinges on the availability of robust, context-appropriate MRV frameworks that capture the impacts of forage quality and animal performance on emissions
- Direct measurement approaches offer the highest accuracy, but they are generally not feasible in LMIC
- MRV system: Tier 2 + participatory monitoring systems
- **Among these, methodologies such as VM0042 and GS Dairy show the greatest alignment with forage-based, smallholder systems**

➤ Integrating low methane forages into carbon methodologies

Recognize LMF as biologically active feed additives (no new infrastructure needed)

Key recommendations:

- Standardize emission factors based on field studies
- Add LMF-specific variables to Tier 2 models (metabolites, dose-response, persistence)
- Regional validation trials (adapt coefficients to local contexts, e.g., LMF project)
- Create LMF modules in methodologies (e.g., VM0042)
- Align with IPCC & carbon standards for crediting in national GHG inventories



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Thank you!

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