Agriculture Methane Emissions and Climate Risks in Ghana

Trends, Policy Pathways and On-Farm Realities

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ACEP
Africa Centre for Energy Policy




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List of Abbreviations

Abbreviation	Meaning
AWD	Alternate Wetting and Drying
BAU	Business-as-Usual
CH_4	Methane
CO_2	Carbon Dioxide
CSA	Climate-Smart Agriculture
CSAIP	Climate Smart Agriculture Investment Plan
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization
FGP	Feed Ghana Programme
FSC	Farmers' Service Centres
GDP	Gross Domestic Product
Gg	Gigagrams (Unit of mass)
GHG	Greenhouse Gas
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
LT-LEDS	Long-Term Low Emissions Development Strategy
LULUCF	Land Use, Land-Use Change and Forestry
MoFA	Ministry of Food and Agriculture
M-RAP	Methane Reduction Action Plan
N_2O	Nitrous Oxide
NAP	National Adaptation Plan
NCCP	National Climate Change Policy
NDC	Nationally Determined Contribution
NPV	Net Present Value
ROI	Return on Investment
SLCP	Short-Lived Climate Pollutant
VS	Volatile Solids

Executive Summary

Agriculture remains central to Ghana's economy, livelihoods, and food systems, contributing approximately one-fifth of national GDP and employing a substantial share of the labour force, particularly in rural areas. However, the sector is increasingly vulnerable to climate change, including rising temperatures, erratic rainfall, prolonged dry spells, and flooding risks, all of which threaten productivity and food security. At the same time, agriculture is also an important source of greenhouse gas emissions. While carbon dioxide dominates Ghana's overall emissions profile, methane is emerging as a particularly important concern because of its high short-term warming potential and its strong linkages with food production systems.

This paper examines methane emissions within Ghana's agricultural sector. It focuses on the scale and drivers of emissions, the policy and institutional landscape, and the practical challenges shaping methane management in the sector. The analysis considers three major methane emissions sources in agriculture: enteric fermentation from livestock, manure management, and flooded rice cultivation. Using recent livestock population trends and IPCC emission factors, the study estimates that methane emissions from livestock through enteric fermentation and manure management could increase by about 90% by 2040, relative to 2024 levels, under Business-As-Usual (BAU) conditions. Similarly, methane emissions from rice cultivation are projected to increase significantly as rice production expands under Ghana's aspirations for food security and import substitution.

A review of Ghana's agricultural and climate policy landscape reveals that while the country does not yet have a dedicated agricultural methane policy, existing frameworks already contain several methane-relevant interventions. Policies such as the Feed Ghana Programme (FGP), the Climate Smart Agriculture Investment Plan (CSAIP), the Nationally Determined Contribution (NDC), and the National Short-Lived Climate Pollutants (SLCP) Action Plan embed measures related to irrigation management, livestock productivity, manure handling, and climate-smart agriculture. Importantly, the ongoing development of Ghana's Methane Roadmap Action Programme (M-RAP) presents an opportunity to consolidate these fragmented efforts into a more coordinated methane mitigation framework.

Financial assessments within the Climate Smart Agriculture Investment Plan show that interventions linked to advisory systems, rice water management, integrated crop-livestock systems, and climate-resilient livestock production record improved metrics under Climate Smart Agriculture scenarios compared to BAU pathways. These reinforce the argument that methane mitigation can simultaneously support climate objectives, agricultural productivity, and long-term economic resilience.

Despite these opportunities, implementation challenges remain significant. Ghana's agricultural systems are dominated by smallholder, low-input, and largely extensive production systems, which constrain the adoption of methane-reducing practices. Limited irrigation control in rain-fed rice systems, weak extension coverage, low farmer awareness, labour concerns, financing constraints, and inadequate infrastructure all limit large-scale uptake. In livestock systems, extensive grazing and dispersed manure deposition complicate centralised manure management approaches. Strengthening methane management within Ghana's agriculture sector therefore requires a more practical, contextually relevant and decentralised approach. The study provides the following recommendations:

1. **Strengthen agricultural extension and farmer support systems for methane-sensitive agriculture:** The Government of Ghana should strengthen extension systems through improved staffing, technical capacity, logistical support, and continuous farmer engagement to support the adoption of practical and locally adapted methane-sensitive agricultural practices across rice and livestock systems.

2. **Link methane mitigation to productivity and resilience benefits:** Awareness and capacity building efforts should frame methane-reducing practices beyond climate benefits alone. All stakeholders that are involved in capacity building must frame methane reducing practices around outcomes farmers value most, including improved yields, water efficiency, livestock productivity, and climate resilience.

3. **Expand incentives and financing support for adoption:** Government and development partners should provide targeted financial support, cost-sharing mechanisms, and incentives that reduce the upfront burden of adopting methane-sensitive agricultural practices.

4. **Institutionalise and sustain implementation of the M-RAP:** Government must embed the M-RAP within existing agricultural and climate governance systems through clear institutional responsibilities, monitoring frameworks, and long-term implementation planning.

5. **Decentralise methane action to reflect local farming realities:** Government must adapt methane mitigation strategies to Ghana's diverse agricultural systems and implemented through district-level planning and extension structures to improve local relevance, ownership, and long-term sustainability.

Introduction

Agriculture remains one of Ghana's most enduring economic pillars. It sustains rural livelihoods, contributes substantially to national output, and underpins the country's food system. Over the past decade the sector has consistently contributed between 18% and 22% of GDP, averaging about 21%. In 2024 it recorded its highest share since 2013, reaching about 22.4% of total GDP. The sector is composed of four subsectors: Crops, Livestock, Forestry and Logging, and Fishing, with the Crops subsector alone accounting for about 80% of sector's contribution to GDP.[1]

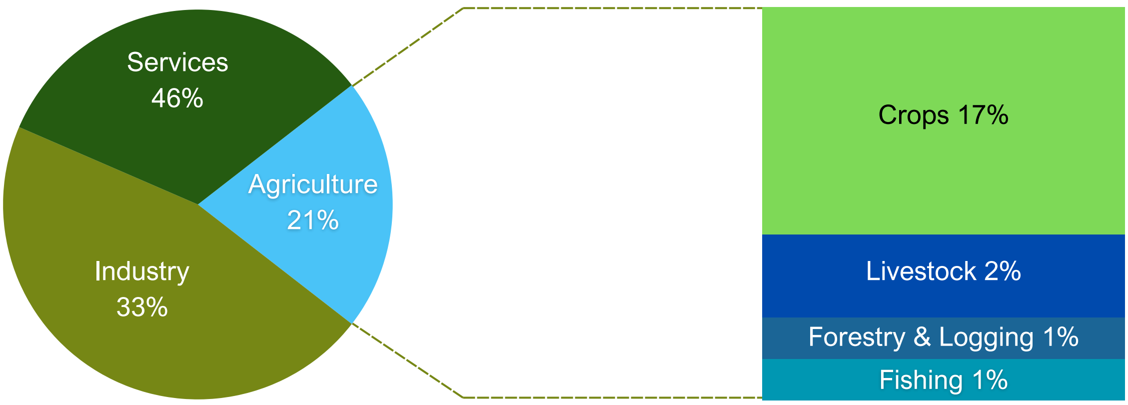


Figure 1: Ghana's GDP according to its major economic sectors

Source: Ghana Statistical Service

Even as the wider economy becomes more service-driven, agriculture continues to provide the foundation for food security, domestic value chains, agro-processing and export competitiveness. Beyond its macroeconomic role, the sector remains central to employment and livelihoods. The 2021 Population and Housing Census shows that about one-third of employed persons aged 15 and above work in skilled agriculture, forestry or fisheries. For women, the sector is particularly significant as about 28% of the female labour force is employed in agriculture.[2] The sector's importance is even more pronounced in rural Ghana, where agriculture accounts for approximately 66% of all employment.

These numbers illustrate that beyond being a production sector, agriculture a livelihood system that shapes household incomes, sustains local markets and contributes to the social and economic stability of rural and urban communities. As such, the performance and resilience of the agriculture sector have direct implications for national development and poverty reduction efforts.

[1] Ghana Statistical Services (2025). Annual 2013 – 2024 GDP. September 2025 edition

[2] Ghana Statistical Service. (2021). 2021 Population and Housing Census: General Report, Volume 3E – Economic Activity.

Climate variability and rising emissions are reshaping the sector's development pathway

Even as agriculture drives economic growth and sustains livelihoods, the sector faces increasing climate stress. Evidence from northern Ghana shows that this vulnerability is already unfolding. For example, Derbile et al. (2022) highlight that smallholder farmers across the northern and transitional zones contend with rising temperatures, erratic rainfall, frequent dry spells and declining soil moisture. These conditions reduce yields and force reactive adaptations such as shifting planting dates or switching crops.[3]

At the community level, Antwi et al. (2015) show that vulnerability is further exacerbated by structural factors including poverty, weak infrastructure, land degradation and limited institutional support.[4] Their assessment in Wa West District reveals that even communities exposed to similar climatic hazards experience different levels of impact depending on their socio-economic and governance conditions. These findings underscore that Ghana's climate vulnerability is both immediate and multi-dimensional, driven by direct climatic stresses and amplified by longstanding development and institutional deficits.

Ghana's climate vulnerability profile show that climate projections reinforce the scale of future risks that the agriculture sector must confront. Mid-century models (2040–2059), relative to the 1995–2014 baseline, show a clear pattern of shifting precipitation across the country.[5] The Southwestern Corridor is projected to become significantly drier, with rainfall reductions exceeding 30 millimetres in some areas. This drying trend threatens high-rainfall crops such as cocoa, rubber and oil palm, and increases the likelihood of prolonged dry spells. In contrast, much of the Northern and Eastern part of Ghana is projected to experience increases in annual rainfall, in some locations rising by 40 to 50 millimetres.[6] While higher precipitation may initially benefit some crops, extreme values raise the risks of flooding, waterlogging, erosion and disruptions to planting calendars. The middle belt is projected to remain closer to long-term norms, though with greater variability and potential shifts in seasonal patterns.

These present and future dynamics create a complex vulnerability landscape for Ghana's agriculture sector. Therefore, any policy response must be grounded in this lived vulnerability context and aligned with broader efforts to build resilience, strengthen institutions and secure agricultural livelihoods.

[3] Derbile, E. K., Bonye, S. Z., & Yiridomoh, G. (2022). Mapping vulnerability of smallholder agriculture in Africa: Vulnerability assessment of food crop farming and climate change adaptation in Ghana. Environmental Challenges, 8, 100537. https://doi.org/10.1016/j.envc.2022.100537

[4] Antwi, E. K., Boakye-Danquah, J., Owusu, A. B., Loh, S. K., Mensah, R., Boafo, Y. A., & Apronti, P. T. (2015). Community vulnerability assessment index for flood-prone savannah agro-ecological zone: A case study of Wa West District, Ghana.Weather and Climate Extremes, 10, 56-69. https://doi.org/10.1016/j.wace.2015.10.008

[5] Desjonqueres, C., Zhao, H., Kosmidou-Bradley, W., & Corral, P. (2024, May). Ghana's climate vulnerability profile (World Bank Report No. P179858). The World Bank. https://documents1.worldbank.org/curated/en/099060524110782274/pdf/P1798581bdf02b0ff1805e1c1c6a5189eb0.pdf

[6] Desjonqueres, C., Zhao, H., Kosmidou-Bradley, W., & Corral, P. (2024). Ghana's climate vulnerability profile. World Bank.

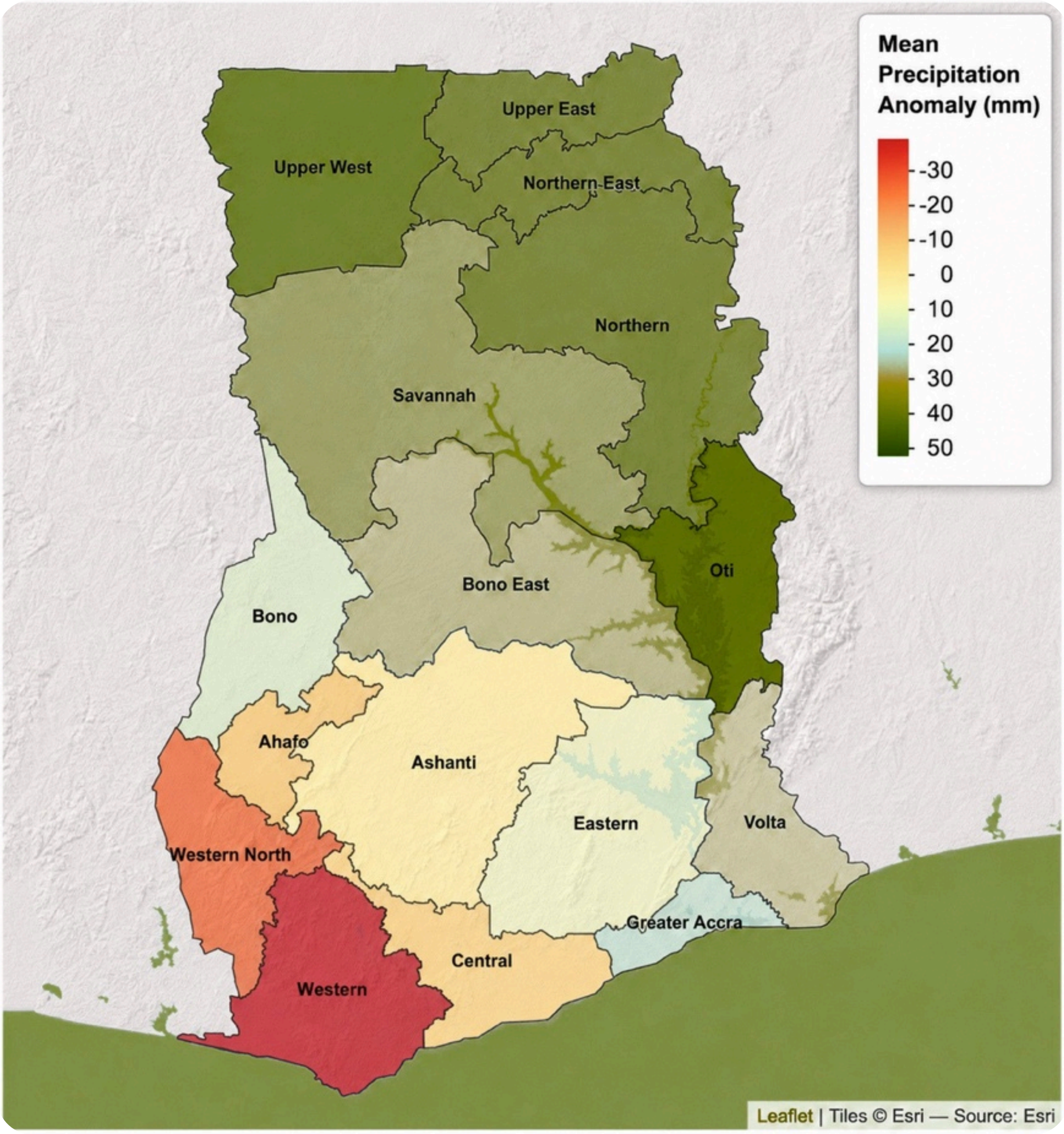


Figure 2: Mean precipitation anomalies in Ghana

Source: World Bank

Agriculture's emissions profile reveals why methane demands closer attention

Amidst these vulnerability concerns, agriculture is also a growing part of Ghana's emissions profile. National greenhouse gas inventories show that the agriculture sector alone accounts for about 21% of total emissions, making it the second-largest emitting sector after energy. When combined with Land Use, Land-Use Change and Forestry (LULUCF), it contributes close to 34% of national emissions, surpassing the energy sector's contributions and emphasising its importance in Ghana's climate pathway (see Figure 3).

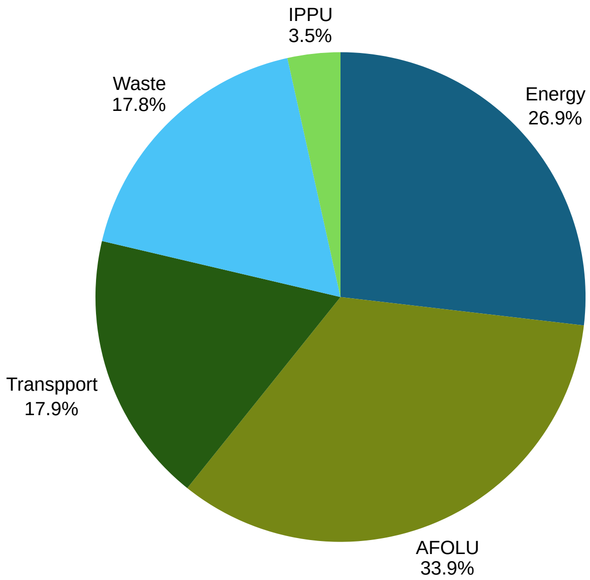


Figure 3: Ghana's greenhouse gas emissions profile

Source: Environmental Protection Authority[7]

Emissions from Ghana's agriculture sector are composed primarily of three greenhouse gases: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). At the national level, and consistent with global patterns, CO_2 is the dominant gas, accounting for about 66% of total emissions in 2021. This dominance also appears in the agriculture sector when emissions are viewed in absolute mass. Agriculture emitted about 7,900 Gigagrams (Gg) of CO_2 in 2021, compared with 181Gg of CH_4 and about 21.1Gg of N_2O. On a mass basis alone, CO_2 clearly dwarfs methane and nitrous oxide.

However, mass is not the most useful metric for understanding climate impact. Methane has a far higher global warming potential, warming the atmosphere about 28 times more than CO_2 over a 100-year period, and nearly 80 times more over 20 years. When agricultural methane is converted into CO_2-equivalent terms, its warming potential expands dramatically, making it one of the most consequential gases in the sector as shown in Figure 4. This is especially important because methane has a short atmospheric lifetime and therefore drives near-term warming more strongly than CO_2 or N_2O.

[7] Environmental Protection Authority (2024). Ghana's first biennial transparency report to the UNFCCC under Article 13 of the Paris Agreement

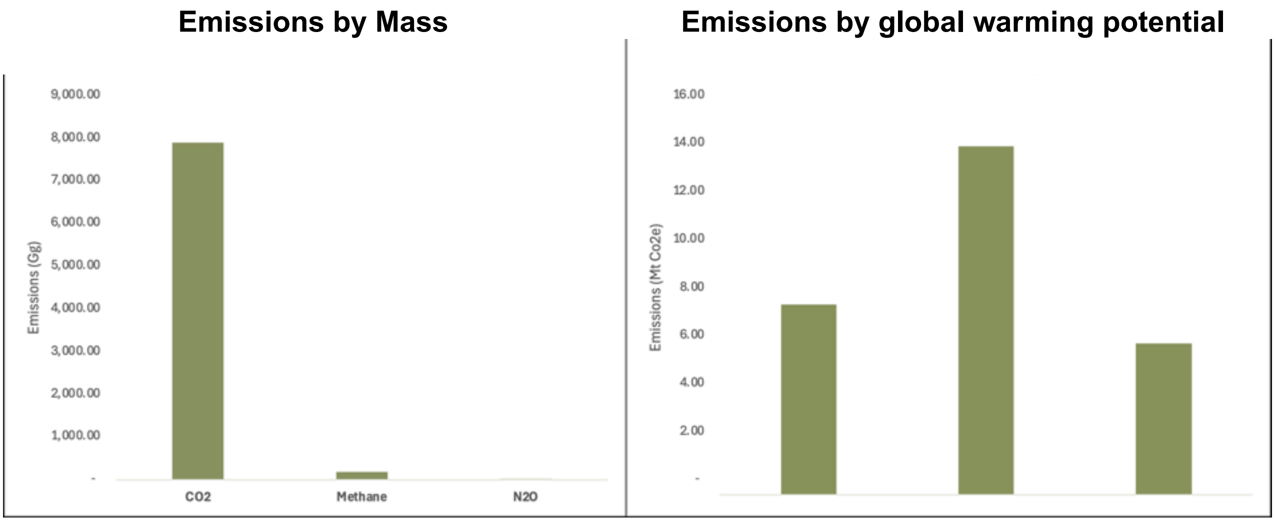


Figure 4: The GWP potential for methane in Ghana's agricultural sector

Source: Ghana Environmental Protection Authority[8]

With Ghana's climate commitments under its Nationally Determined Contribution (NDC) and growing pressure on food system stability, the short-term warming impact of methane is particularly urgent. The success of food security policies such as the Feed Ghana Programme can be significantly undermined without climate action, particularly methane reductions, as near-term warming could threaten productivity. This makes methane abatement in Ghana's agricultural sector a strategic priority for both climate action and food security.

Against this backdrop, this paper examines the role of methane in Ghana's agriculture sector. It reviews the scale and trends of agricultural methane emissions, analyses the degree to which existing strategies and institutional frameworks recognise and prioritise methane, and identifies gaps that limit effective action. The paper demonstrates the economic rationale of effective methane management in Ghana's agriculture sector. It shows how methane fits within Ghana's broader agricultural and climate agenda and explore how policy attention can be strengthened to support both climate goals and sector productivity.

This paper is organised into five chapters. The succeeding chapter details Ghana's methane profile in the agriculture sector, highlighting the various sources and emissions projections up to 2040. The subsequent chapter examines sector and climate related policies that are directly or indirectly linked to methane management in Ghana's agriculture sector. The challenges to effective methane management are examined in the fourth chapter while the last chapter concludes and provides relevant recommendations for policy action.

[8] Environmental Protection Authority (2024). Ghana's Fourth Biennial Update Report to the United Nations Framework Convention on Climate Change.

Ghana's agriculture sector methane profile

Methane is classified as a short-lived climate pollutant because it remains in the atmosphere for a relatively brief period of about 12 years on average, compared with CO_2 which can persist for centuries. Yet despite this shorter lifetime, it exerts a disproportionately large warming effect. The global warming potential of methane establishes its potency as a greenhouse gas.[9,10] In addition to its climate effects, methane drives the formation of ground-level ozone, a pollutant associated with reduced lung function, increased respiratory symptoms and premature mortality.[11] These combined climate and health impacts make methane management a critical target for rapid mitigation especially for countries like Ghana that already face significant climate vulnerability and growing pressure to strengthen air quality and public health outcomes.

Methane arises from both natural and human-induced processes, but globally, anthropogenic sources make up about 60% of total methane emissions. These emissions primarily originate from three sectors: agriculture, waste, and the energy sector.

Estimates of global methane emissions vary across institutions due to differences in methodologies, sectoral classifications, data sources, and the year of estimation. For example, the World Resources Institute's estimates for 2023 indicate that agriculture accounted for about 42% of global methane emissions, followed by the energy sector at about 38%.[12] Similarly, the International Energy Agency's methane tracking assessment for 2023 estimates that agriculture contributed about 40% of global methane emissions, closely following the energy sector, which accounted for approximately 41% of total emissions.[13] Nevertheless, there is broad consensus that the agriculture and energy sectors remain the two largest sources of methane emissions globally.

[9] Methane has a global warming potential roughly 28 times that of CO_2 over 100 years, and close to 80 times higher over a 20-year period

[10] Mar, K. A., Unger, C., Walderdorff, L., & Butler, T. M. (2022). Beyond CO_2 equivalence: The impacts of methane on climate, ecosystems, and health. Environmental Science & Policy, 134, 127-136. [1] Environmental Protection Authority (2024). Ghana's Fourth Biennial Update Report to the United Nations Framework Convention on Climate Change.

[11] Ofori, C. G., & Osei, C. S. (2024). Environmental and health impacts of methane emissions. Africa Centre for Energy Policy.

[12] Climate Watch Historical GHG Emissions. 2026. Washington, DC: World Resources Institute. Available online at: [1] Environmental Protection Authority (2024). Ghana's Fourth Biennial Update Report to the United Nations Framework Convention on Climate Change.

[13] International Energy Agency (2023), Methane Tracker Database, IEA, Paris. License: Creative Commons Attribution CC BY 4.0.

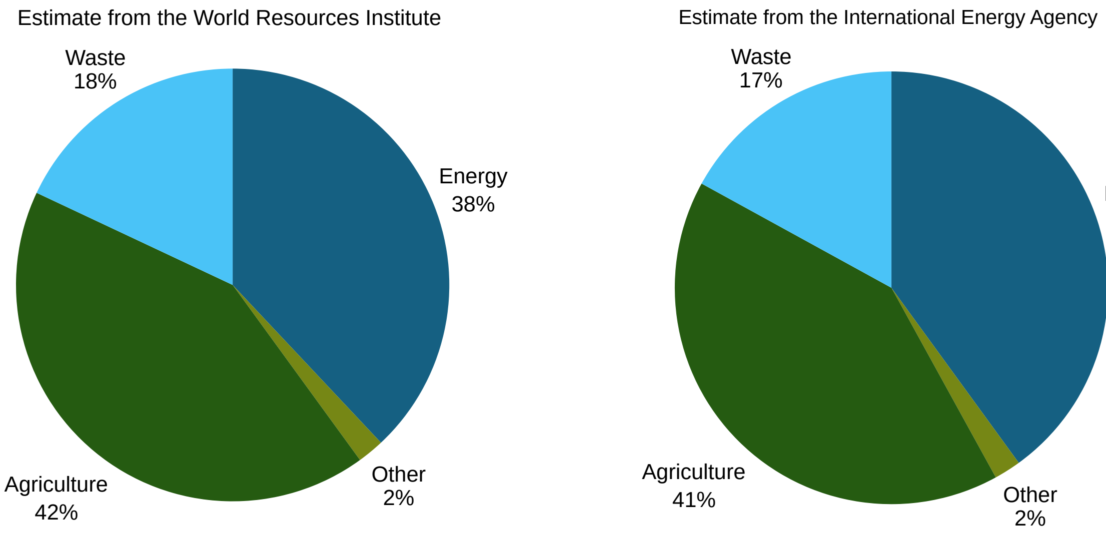


Figure 5: 2023 Methane emission estimates from IEA and WRI

Sources: World Resources Institute; International Energy Agency

In Ghana, methane is the second largest greenhouse gas, mirroring global emission patterns. National inventory data show that in 2022 methane accounted for about 31% of total emissions. Methane emissions were primarily driven by the waste sector, which accounted for approximately 44.8% of total methane emissions. Agriculture followed with about 31.8%, while the energy sector contributed about 23.4% (see Figure 5).[14]

Despite waste being the current largest methane source, agriculture remains a critical sector for methane mitigation because emissions are closely linked to food production systems that are expected to expand considering Ghana's desire for agricultural transformation and food security. In addition, many methane-reducing interventions in agriculture can simultaneously improve productivity, resilience, and farmer livelihoods, creating important development co-benefits alongside emissions reductions.

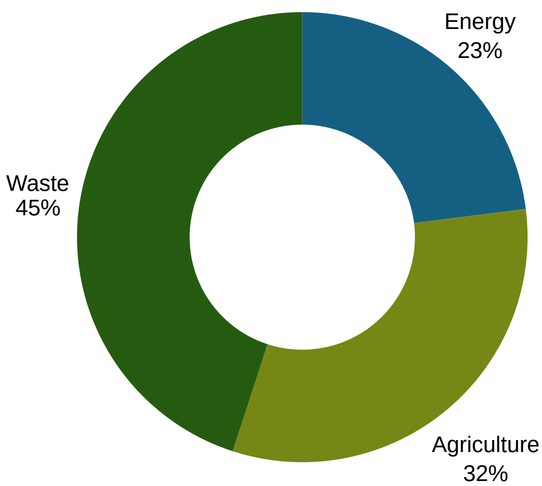


Figure 6: Ghana's methane emissions profile

Source: Environmental Protection Authority

[14] Environmental Protection Authority (2024). Ghana's first biennial transparency report to the UNFCCC under Article 13 of the Paris Agreement

Within Ghana's agriculture sector, methane emissions arise from a set of well-known biological and management processes. The most significant sources are enteric fermentation from ruminant livestock, manure management, and rice cultivation, particularly under continuously flooded conditions. Smaller contributions emerge from on-farm waste handling and biomass burning associated with land preparation. The ensuing section provides a more detailed examination of these sources and the factors influencing their emission pathways.

Methane emissions through enteric fermentation from livestock

Methane emissions from livestock arise primarily through enteric fermentation, a natural digestive process in ruminant animals such as cattle, sheep and goats. Ruminant diets are typically high in fibrous plant material, with varying levels of lipids and starch. The feed is broken down by microbes housed in the rumen, the first and largest chamber of their four-part stomach. These microbes ferment plant material to produce volatile fatty acids and microbial protein, while also synthesising vitamins such as B vitamins and vitamin K.[15] Methane is released as a by-product of this fermentation and expelled mainly through belching. In contrast, monogastric animals such as pigs and poultry generate far lower methane emissions because they lack this specialised rumen system.

The estimation of methane emissions from livestock depends on a wide range of animal- and system-specific factors. Emission factors are influenced by feed quality and quantity, animal breed and body size, productivity level, health status, reproductive stage, and environmental conditions such as temperature and grazing systems. According to the Food and Agriculture Organization (FAO), ruminants typically lose between 2% and 12% of their gross energy intake as methane, with losses at the upper end of this range most common in tropical regions where animals consume low-quality, fibrous feeds.[16]

Emission factors vary substantially between livestock species, as well as within species. For example, cattle emit far more methane than sheep or goats because they have larger rumens and consume greater quantities of forage. Additionally, feeds with lower digestibility produce comparatively more methane emissions. Even within cattle, dairy cattle have higher emission factors than non-dairy (beef or draft) cattle.[17] This is because dairy animals consume more feed, have higher metabolic demands, and sustain longer periods of elevated intake to maintain milk production. These factors increase fermentative activity in the rumen and therefore methane output.

According to the Ministry of Food and Agriculture's (MoFA) Agriculture Facts and Figures (2024), Ghana's livestock population has grown steadily over the past decade, with estimated annual growth rates of about 3.7% for cattle and sheep, 4.6% for goats, and 4.8% for pigs. As of 2024, the combined population of cattle, sheep, goats and pigs was about 19.3 million. Small ruminants (sheep and goats) accounted for about 82% of this total, while cattle represented roughly 12%. These livestock population data are a core input for estimating agricultural methane emissions in Ghana's national greenhouse gas inventory.

[15] Holtzapple, M. T., Wu, H., Weimer, P. J., Dalke, R., Granda, C. B., Mai, J., & Urgun-Demirtas, M. (2022). Microbial communities for valorizing biomass using the carboxylate platform to produce volatile fatty acids: A review. Bioresource Technology, 344, 126253.

[16] Food and Agriculture Organization of the United Nations. (n.d.). Reducing enteric methane for improving food security and livelihoods. FAO. https://openknowledge.fao.org/server/api/core/bitstreams/4ce2b8f0-15a0-4317-bce3-4f14122be4f1/content

[17] Intergovernmental Panel on Climate Change. (2006). 2006 IPCC guidelines for national greenhouse gas inventories: Volume 4 — Agriculture, forestry and other land use. Chapter 10: Emissions from livestock and manure management. IPCC National Greenhouse Gas Inventories Programme. https://www.ipccnggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf

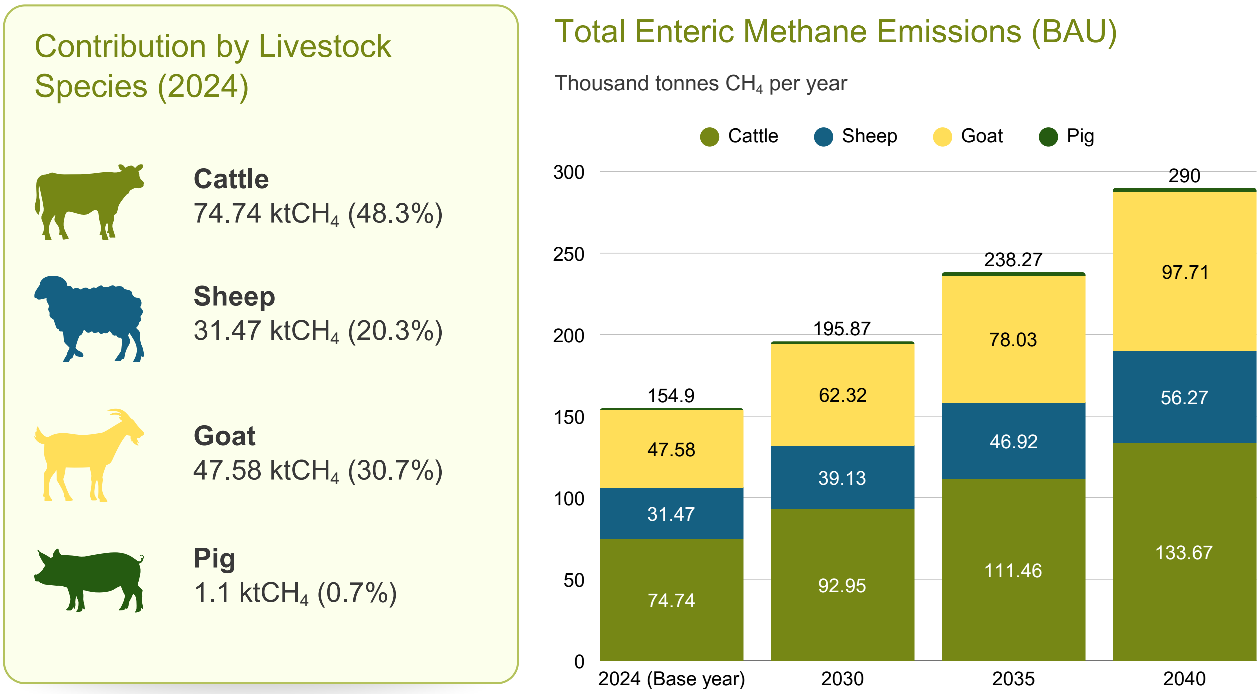
Livestock	Production ('000)					Emission factor (kg CH_4/head/yr)
	2020	2021	2022	2023	2024	
Cattle	2,109	2,174	2,237	2,320	2,411	31
Sheep	5,544	5,695	5,901	6,105	6,293	5
Goat	8,180	8,411	8,795	9,135	9,516	5
Pig	946	785	1,028	1,004	1,112	1

Table 1: Ghana's livestock production and enteric fermentation emission factors

Sources: Ministry of Food and Agriculture; IPCC

Business-as-usual projections based on recent livestock growth trends and IPCC emission factors indicate that enteric methane emissions from Ghana's livestock sector could rise by about 90% by 2040, relative to 2024 levels, if no mitigation measures are introduced (see Figure 7). This underscores the growing importance of effective methane management across the livestock sector.

Within this trend, cattle remain the dominant source of enteric methane emissions despite representing a smaller share of the national herd. Their higher emission intensity, driven by larger body size, greater feed intake, and more extensive rumen fermentation, means that each head of cattle emits several times more methane than sheep, goats or pigs. The BAU estimates suggest that measures to reduce methane from enteric fermentation, particularly in the cattle sub-sector through improved feed quality, animal health and breeding will be highly relevant to Ghana's methane mitigation pathway.



Under Business-as-Usual (BAU) conditions, methane emissions from enteric fermentation in Ghana's livestock sector are projected to increase by **28.5%** by **2030**, **56.2%** by **2035** and **89.9%** by **2040** compared to 2024 levels.

Figure 7: Projected enteric methane emissions from Livestock in Ghana (BAU)

Source: Author's construct with data from MoFA and IPCC

Methane emissions through manure management

Methane emissions also arise from management of livestock manure, particularly animal dung. When manure decomposes in low oxygen conditions, it produces methane. This process is most common in wet or compacted conditions, such as lagoons, pits, slurry tanks, or poorly aerated heaps, which create favourable conditions for methane formation.

Methane emissions from manure depend on several interacting factors, beginning with the quantity of manure produced, which varies by animal type and generally increases with body weight and feed intake. The methane-generating potential of this manure is strongly influenced by its volatile solids (VS) content. Volatile solids are the biodegradable organic materials in manure, such as undigested feed residues, fibre, fats and proteins, which microbes can break down under anaerobic conditions.[18] Because these materials provide the substrate for microbial decomposition, higher VS content generally increases the potential for methane production.

The manure management system is another driver of emissions. Liquid systems such as lagoons, tanks and pits create oxygen-poor environments ideal for methane formation. On the other hand, dry systems like solid heaps, dry feedlots, daily spreading or unmanaged pasture deposits typically allow aerobic decomposition and therefore emit far less methane. Climate conditions further shape the process. Warm temperatures accelerate microbial activity in liquid

[18] Intergovernmental Panel on Climate Change. (2006). 2006 IPCC guidelines for national greenhouse gas inventories: Volume 4—Agriculture, forestry and other land use. Chapter 10: Emissions from livestock and manure management. IPCC National Greenhouse Gas Inventories Programme. https://www.ipccnggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf

systems, and wet conditions can elevate emissions from solid systems, although overall methane output from solid storage remains low.

Methane emissions from manure management are generally lower than those from enteric fermentation as their emission factors are comparatively lower. However, methane generation still occurs and varies by livestock species, manure handling practices, and Ghana's warm tropical climate, which tends to increase methane formation.

IPCC's default emission factors indicate that in warm climates, manure from sheep and goats emits about 0.21 and 0.23 kg CH_4/head/year respectively, while cattle manure emits about 1 kg CH_4/head/year. Pig manure has a higher default emission factor of about 2 kg CH_4/head/year.[19] This factor reflects the greater methane potential of wetter and more concentrated waste systems often associated with pig production.

Cattle are likely to remain an important source of manure methane because of herd size and manure volume, while piggery units may generate comparatively higher emissions per animal. Improved manure management in cattle and pig production systems could therefore deliver meaningful methane reductions in Ghana.

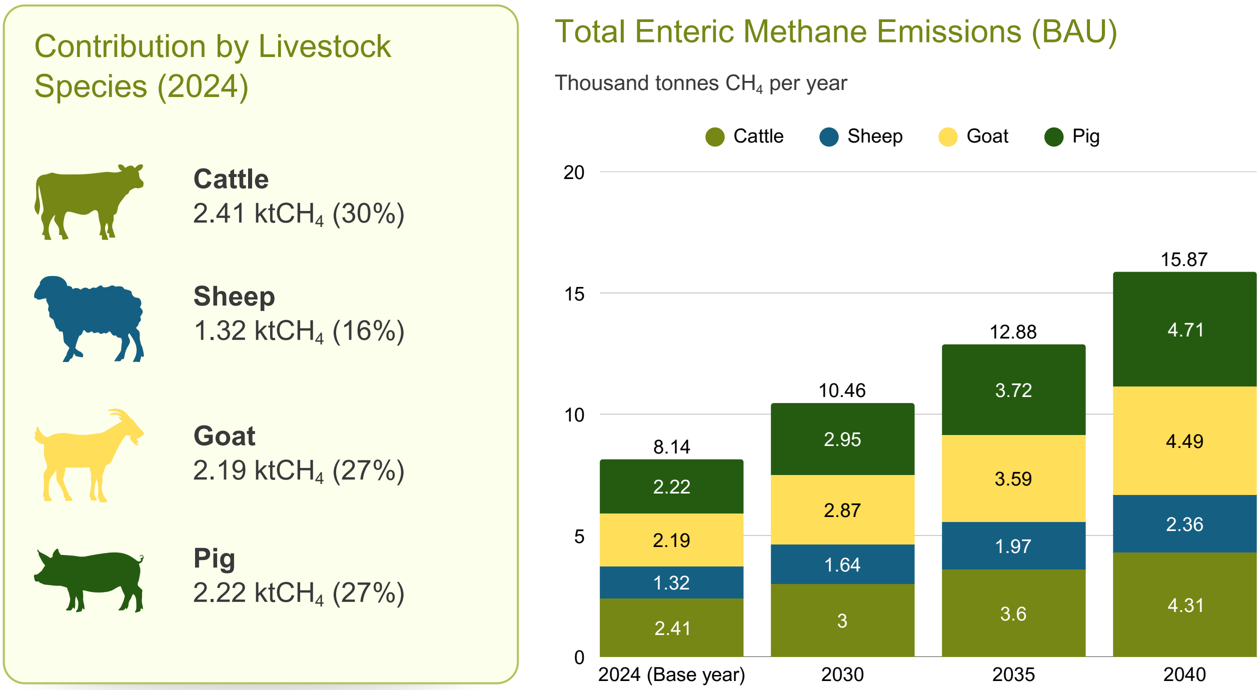
Livestock	Emission Factors (kg/head/year)		
	Cool (<15 degree C)	Temperate (15-25 degree C)	Warm (>25 degree C)
Sheep	0.10	0.16	0.21
Goat	0.10	0.20	0.23
Dairy Cattle	1.00	1	1
Non-Dairy Cattle	0	1	1
Pig	0	1	2

Table 2: Livestock methane emission factors from manure management according to climatic zones

Source: IPCC

[19] Intergovernmental Panel on Climate Change. (2013). 2006 IPCC guidelines for national greenhouse gas inventories: Volume 4—Agriculture, forestry and other land use. Chapter 3: Emissions from animal manure management. IPCC National Greenhouse Gas Inventories Programme.

Business-as-usual projections based on recent livestock growth trends and IPCC emission factors indicate that methane emissions from manure management in Ghana's livestock sector could rise by 95% by 2040, relative to 2024 levels, if current manure handling practices remain unchanged. Although some livestock categories have lower manure methane emission factors than others, their large population sizes still result in substantial aggregate emissions. The relatively balanced distribution of manure methane emissions across cattle, goats, sheep and pigs suggests that effective methane mitigation will require improvements in manure handling, storage, treatment and nutrient recovery across livestock systems rather than focusing on a single animal category.



Under Business-as-Usual (BAU) conditions, methane emissions from manure management in Ghana's livestock sector are projected to increase by **28%** by **2030, 58%** by **2035** and **95%** by **2040** compared to 2024 levels.

Figure 8: Estimation of methane emissions from livestock manure management

Sources: Ministry of Food and Agriculture; IPCC

Methane emissions from rice production

Methane emissions from rice cultivation arise mainly in flooded paddy systems, where waterlogged soils prevent oxygen from entering the root zone. Once the soil becomes oxygen-poor, normal decomposition slows down and shifts into an anaerobic process that generates methane.[20] The organic materials that feed this process come from the rice crop itself as well as from any organic matter left in or added to the field, including rice straw, manure, compost or green manure. Fields with high levels of plant residues or added organic inputs therefore tend to

[20] Intergovernmental Panel on Climate Change (IPCC). (2000). Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories: CH_4 emissions from rice agriculture (Chapter 4.7). Institute for Global Environmental Strategies (IGES) for the IPCC National Greenhouse Gas Inventory Programme. https://www.ipcc-nggip.iges.or.jp/public/gp/bgp/4_7_CH4_Rice_Agriculture.pdf

release more methane, especially when they remain flooded for long periods.[21]

Methane produced in flooded rice fields can move from the soil into the atmosphere in a few different ways. Some escape slowly through the water (diffusion), while others are released as bubbles when gas builds up underground (ebullition). A portion may also be broken down naturally in the soil when oxygen is present. But the most important pathway is plant-mediated transport. Rice plants have tiny pores in the sheaths of their lower leaves, and these act like small channels that carry methane directly from the flooded soil into the air. Research shows that this plant pathway forms about 90% of the methane released from rice paddies.[22]

An important feature of methane dynamics in rice fields is that not all the methane produced in flooded soils reaches the atmosphere. A substantial share can be oxidised by methane-consuming microorganisms (methanotrophs) in the oxygenated zones surrounding rice roots and near the soil-water interface. Studies have shown that methane oxidation can significantly reduce net emissions from rice paddies, in some cases consuming more than half of the methane produced before it escapes to the atmosphere. The extent of oxidation is influenced by factors such as rice growth stage, root oxygen release, water management, soil conditions, and microbial activity.[23] As rice plants mature, increased root development and oxygen transport can enhance methane oxidation in the rhizosphere.[24] However, seasonal methane emission patterns vary across production systems and are also strongly affected by water regime, organic matter availability, and temperature.

Methane emissions from rice production are typically estimated based on the area of land under cultivation, measured as methane released per hectare per day. This approach reflects the fact that the key driver of methane formation is the management of the rice field rather than the rice grain itself. According to the IPCC 2019 Refinement, the baseline emission factor for continuously flooded, irrigated rice systems is 1.19 kg CH_4 per hectare per day. This value is widely used in national greenhouse gas inventories to calculate emissions from rice paddies. Most rice farms in Ghana are managed as irrigated or rain-fed lowland systems that remain flooded for long stretches of the growing season. These prolonged anaerobic conditions create an ideal environment for methane production throughout much of the crop cycle.

Historical rice cultivation data indicate that rice cultivated land size in Ghana has expanded significantly over the past decade, although the pace of growth has varied considerably over time. Year-on-year growth rates remained relatively modest between 2015 and 2017, averaging below 3%, before accelerating substantially between 2018 and 2023, when annual growth rates exceeded

[21] Rajendran, S., Bhuvaneswari, K., Murugan, A., Ragunathan, T., Malarvizhi, P., Arunkumar, K., & Paramasivan, M. (2024). Methane emission from rice fields: Necessity for integrated management. Environmental Technology & Innovation, 29, 103406. https://doi.org/10.1016/j.eti.2023.103406

[22] Islam, S. F. U., Sander, B. O., Quilty, J. R., De Neergaard, A., Van Groenigen, J. W., & Jensen, L. S. (2020). Mitigation of greenhouse gas emissions and reduced irrigation water use in rice production through water-saving irrigation scheduling, reduced tillage and fertiliser application strategies. Science of The Total Environment, 739, 140215.

[23] Intergovernmental Panel on Climate Change (IPCC). (2000). Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories: CH_4 emissions from rice agriculture (Chapter 4.7). Institute for Global Environmental Strategies (IGES) for the IPCC National Greenhouse Gas Inventory Programme. [1] Rajendran, S., Bhuvaneswari, K., Murugan, A., Ragunathan, T., Malarvizhi, P., Arunkumar, K., & Paramasivan, M. (2024). Methane emission from rice fields: Necessity for integrated management. Environmental Technology & Innovation, 29, 103406. https://doi.org/10.1016/j.eti.2023.103406

[24] Rhizosphere refers to the narrow zone of soil directly surrounding plant roots. At the rhizosphere, biological and chemical activity is strongly influenced by root processes, including the release of oxygen and organic compounds that support microbial activity.

8% and peaked at nearly 15% between 2020 and 2021 (see Figure 9). The rapid expansion observed during this period likely reflects a combination of policy interventions aimed at improving rice self-sufficiency. However, the near-flat growth observed between 2023 and 2024 suggests that the rapid expansion phase may begin moderating over time due to constraints related to land availability, irrigation potential, water access, and competing agricultural land uses.

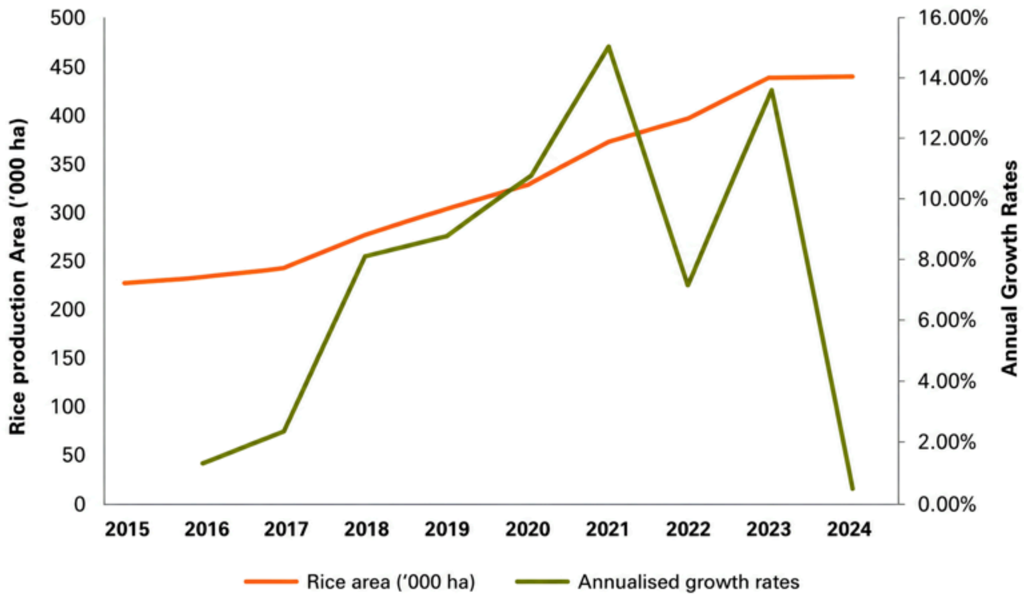


Figure 9: Growth in land area for rice production in Ghana (2015-2024)

Source: Ministry of Food and Agriculture

Given these trends, the analysis adopts a moderated business-as-usual (BAU) projection pathway that reflects continued expansion in rice cultivation while accounting for the likelihood of gradual slowing over time. Although the long-run annualised growth rate between 2015 and 2024 is estimated at approximately 7.2%, sustaining this level of expansion through 2040 is considered unlikely under prevailing land and resource constraints. The projection therefore assumes a conservative uniform annual growth of 3%. Using a baseline cultivated area of 434,000 ha in 2024, projected rice cultivated area reaches about 700,000 ha by 2040.

Methane emissions from rice cultivation were estimated using an activity-based approach that combines cultivated rice area, a methane emission factor, and the cultivation period. The analysis applies the IPCC default methane emission factor for rice cultivation in Africa of 1.19 kg CH_4 ha^{-1} day^{-1}, with an uncertainty range of 0.80–1.76 kg CH_4 ha^{-1} day^{-1}. The estimation further assumes a central cultivation period of 120 days, based on the maturity periods of commonly cultivated rice varieties in Ghana, which generally range between approximately 90 and 140 days.[25] Methane emissions were estimated using the formula:

Using a baseline cultivated rice area of 434,000 ha in 2024 and a 3% annual cultivated area growth rate, methane emissions from rice cultivation are estimated at approximately 62 $ktCH_4$. Under the business-as-usual (BAU) projection pathway for rice area expansion, methane emissions are projected to increase to about 99 $ktCH_4$ by 2040, representing a 60% increase

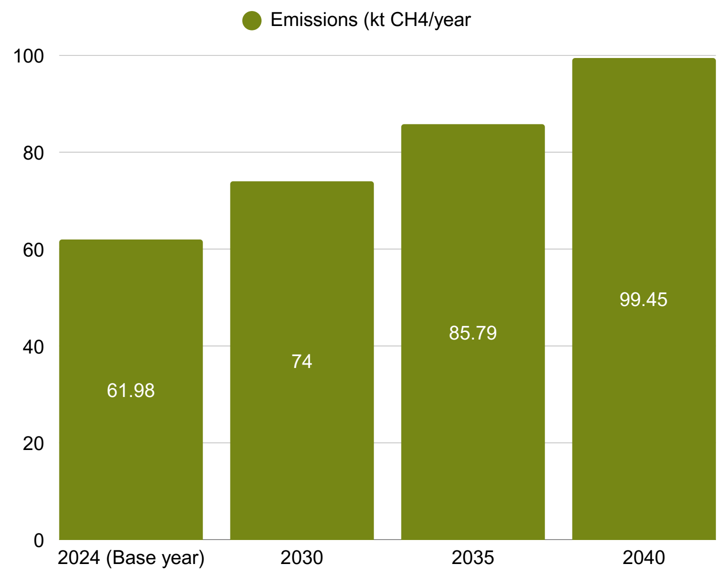
[25] Ministry of Food and Agriculture (2020). Rice production guide 2020. Available at https://mofa.gov.gh/site/images/pdf/production_guides/RICE_Production_Guide.pdf

relative to 2024 levels. The projections also show that emissions are highly sensitive to increases in cultivated area. For example, under a 4% annual growth scenario, emissions could rise to about 116 ktCH_4 by 2040, corresponding to an 87% increase relative to 2024 levels.

The projections highlight an important trade-off between rice expansion and methane emissions. While increasing rice production remains critical for food security and reducing import dependence, expansion under conventional production systems is likely to increase methane emissions substantially. This means the challenge is not to slow rice production growth, but to expand production alongside methane abatement. Consequently, improved water management, irrigation efficiency, residue management, and other low-emission rice cultivation practices will be increasingly important for balancing agricultural growth with climate objectives.

Projected methane emission from rice Cultivation (BAU)

Thousand tonnes CH_4 per year



Inputs and assumptions

Emissions factor

1.19

kg CH_4/ha/day

Assumed cultivation season

120

days

Under Business-as-Usual (BAU) conditions, methane emissions from rice cultivation in Ghana are projected to increase by **19%** by **2030**, **38%** by **2035** and **60%** by **2040** compared to 2024 levels.

Figure 10: Estimation of methane emissions from rice production

Source: Ministry of Food and Agriculture; IPCC

Dealing with methane emissions from the agriculture sector

The preceding sections have shown that agriculture is one of Ghana's major sources of methane emissions, driven mainly by livestock, manure handling and flooded rice cultivation. Methane emissions from agriculture are highly sensitive to farm practices, hence can be lowered through practical, field-level changes that do not compromise productivity. Ghana's national climate strategies identify several priority interventions that align with both mitigation and agricultural development goals. These approaches focus on improving water management in rice systems, enhancing livestock feed and herd productivity, and shifting farmers toward more controlled manure handling systems. The key mitigation approaches are summarised in Table 3.

The interventions outlined in Table 3 are largely low-regret options that deliver immediate climate benefits that reinforces Ghana's broader objectives for agricultural productivity and resilience. Rather than requiring an entirely new policy architecture, effective methane mitigation can be achieved through sharper prioritisation and more consistent implementation within existing frameworks.

Approach	How It Works	Methane Reduction Mechanism	Relevance to Ghana
1. Sustainable Rice Cultivation (e.g., Alternate Wetting and Drying (AWD))	Fields are allowed to dry periodically instead of remaining continuously flooded. Farmers alternate between wet and dry soil conditions while maintaining yields.	Drying breaks the anaerobic conditions that sustain methane production. Reduces CH_4 emissions by 30–70% depending on field conditions.	Ghana's lowland irrigated rice systems stay flooded for long periods. AWD is one of the most practical mitigation options.
2. Improved Livestock Feed and Herd Management	Enhancing diet quality, introducing high-digestibility feed and managing grazing. Feed additives may be explored in future trials.	Better-quality feed reduces enteric fermentation, lowering CH_4 production.	Livestock contributes a significant portion of Ghana's agricultural methane. Feed quality in among extensive cattle rearing systems is usually poor, creating strong potential for improvement.
3. Improved Manure Management	Transitioning from unmanaged waste piles and open dumping to controlled systems such as composting, dry stacking, covered storage, or biodigesters.	Reduces anaerobic decomposition of volatile solids. Composting introduces oxygen, biodigesters capture CH_4 for energy instead of allowing release.	Ghana's manure systems are mostly unmanaged. Even small improvements (e.g. covering pits, shifting to compost) can significantly cut methane emissions.
4. Water and Land Management in Rice Valleys	Better levelling, drainage canals, bund reinforcement, and controlled water delivery in inland valleys.	Improved drainage prevents prolonged continuous flooding, thereby reducing CH_4 formation.	Many rice-growing sites rely on poorly controlled water systems. Basic field engineering can create major methane reductions at low cost.
5. Rotational Cropping and Short-Duration Varieties in Rice	Using rice-upland crop rotations or shorter-duration rice varieties to reduce total flooded days.	Fewer anaerobic days means less CH_4 generation. Shorter maturity periods reduce cumulative emissions per season.	MoFA promotes 100–120-day varieties. Adoption supports both yield stability and methane mitigation.

Table 3: Solutions to dealing with agricultural sector methane emission

A policy scan of methane abatement in Ghana's agricultural sector

Ghana currently does not have a fully operational standalone policy or regulatory framework specifically dedicated to methane abatement in the agric sector. Existing policies are generally framed around broader objectives such as agricultural productivity, food security, climate resilience, irrigation development, livestock improvement, and sustainable land management. However, many of the interventions proposed under these frameworks intersect strongly with methane-generating systems, particularly rice cultivation, enteric fermentation, and manure management.

The relevance of Ghana's existing policy architecture to methane mitigation therefore lies less in explicit references to methane, and more in the extent to which they create institutional, technical, and investment entry points for methane-sensitive interventions. This chapter therefore examines the extent to which existing agricultural and climate-related policies in Ghana implicitly support methane mitigation. It also examines the degree of integration of these policies across sectors, and the opportunities that exist to strengthen explicit methane governance within the country's broader agricultural transformation and climate policy agenda.

The Feed Ghana program (FGP)

The Feed Ghana Program (FGP) is the Government of Ghana's new flagship program to provide food for citizens and raw materials for the agro industry.[26] The Programme sets out an ambitious agenda for revitalising Ghana's agriculture, centred on productivity growth, food security, import substitution and value-chain modernisation. The FGP aims to transform Ghana's agricultural sector over four years (2025-2028) through six core objectives:

1. Increase agricultural productivity and production to reduce imports (e.g., rice yields to 4.8 Mt/ha, maize to 4.05 Mt/ha)
2. Enhance food security, reduce the cost of a healthy diet and improve nutritional outcomes (e.g. reach at least 100% self-sufficiency in rice, maize and soybean by 2028)
3. Increase raw material supply for agro-processing
4. Promote value addition and agro-industrial growth.
5. Boost agricultural exports by at least 20%.
6. Create jobs (e.g. 2.6 million direct/indirect jobs by 2028)

The FGP is framed largely as an agronomic and economic transformation plan. However, it embeds several climate-resilient priorities. Its commitment to improving irrigation management, upgrading agro-mechanisation, introducing climate-smart technologies through Farmers' Service

[26] Ministry of Food and Agriculture (2025). Feed Ghana Programme (FGP). A Four-Year Agricultural Transformation. Programme (2025 - 2028)

Centres (FSCs), and promoting better post-harvest and waste-handling systems aligns with techniques already recognised in global climate mitigation literature.

The program embeds important measures that have direct implications for methane management in the agriculture sector. These include irrigation system expansion (which enables methane-reducing water regimes in rice production), improvements in animal nutrition and breeding (enteric fermentation methane abatement), and better manure management practices. The policy's emphasis on climate-smart agriculture, resilience, and sustainability provides an enabling framework for methane-focused interventions, although not explicitly mentioned in the policy text.

The programme's relevance to methane mitigation also lies in the structural reforms it proposes. For example, the programme's attention to farmer cooperatives and targeted support to smallholders is crucial because methane-reducing interventions requires targeted and holistic capacity building initiatives. The FGP's structure therefore creates a practical policy entry point for methane management by strengthening the institutional and infrastructural foundations needed to adopt mitigation technologies at scale. This policy provides an opportunity for stakeholders to more explicitly harness and scale existing interventions for methane mitigation within its current framework.

The Climate Smart Agriculture Investment Plan (CSAIP) for Ghana

The CSAIP is designed as a strategic investment roadmap rather than a classical policy document. Its primary purpose is to identify, prioritise and cost large-scale agricultural investments that can simultaneously deliver productivity gains, climate resilience, and mitigation co-benefits. It provides a structured framework for mobilising finance and coordinating interventions under a unified Climate-Smart Agriculture (CSA) agenda.

The CSAIP outlines nine priority investment areas across crops, livestock, irrigation, climate-information services and institutional strengthening. Each investment area is assessed for cost, implementation feasibility, environmental impact and climate-mitigation potential. The CSAIP also does not explicitly target methane, however some of its interventions are either directly or indirectly linked to methane management in agriculture. The table below outlines the various investment interventions while detailing each action's relevance to methane management.

CSAIP Intervention	Description	Methane Relevance Level	Justification
1. Knowledge systems and advisory services supporting CSA	Establish robust research and extension services, leveraging ICT, to augment farmer productivity, adaptivity, and mitigation in the face of climate change.	High	Does not target methane directly. However, extension and advisory services are important to drive effective education on AWD, effective manure management and feed improvement practices for methane abatement.
2. Integrated Water Resource Management for Rice	Fully leverage Ghana's water resources in sustainable ways to improve productivity, nutritional security, climate resiliency, and ecological health.	High	Methane in rice cultivation is strongly driven by water management. Although AWD is not explicitly stated, the intervention's emphasis on deliberate water control directly aligns with methane-reducing practices.
3. Cereal–Legume Integration	Improved cereal-legume rotations, soil fertility and reduced tillage.	Moderate	The methane relevance of cereal–legume integration depends on the production system in which it is applied. For example, rice–upland crop rotations and the use of shorter-duration rice varieties can directly reduce methane emissions by shortening flooding periods and interrupting anaerobic soil conditions responsible for methane formation.
4. Climate Smart Cocoa Production	Sustain and expand Ghana's agricultural economy through climate-smart innovations in the production of cocoa	Low	This intervention involves cocoa production and has little or no linkage with livestock or rice production.
5. Climate resilient poultry production	Revitalize the Ghanaian poultry sector with climate-smart approaches in feed production and genetic resource enhancement	Low	Poultry has almost no direct methane emissions, but improved manure handling and feed systems can have spillover benefits for mixed crop–livestock farms.
6. Climate resilient ruminant and genetic resource conservation	Use climate-smart techniques to increase the resource-use efficiency and climate resiliency of ruminant production.	High	This intervention explicitly involves livestock at scale. Improved feed quality can reduce enteric methane intensity, and manure reuse reduces unmanaged decomposition. This is a primary livestock methane reduction opportunity in the CSAIP.
7. Sustainable fisheries and aquaculture	Ensure the continued growth aquaculture industry by using climate-smart practices to establish the sustainable fish production	Low	Aquaculture systems emit minimal methane compared to rice or livestock. Relevance only occurs if integrated with rice fields where water retention patterns shift.
8. Diversified tree crops	Employ agroforestry techniques to make cashew, oil palm, and possibly plantain production climate smart.	Low	Huge for carbon sequestration, erosion control and income.
9. Root and tubers-livestock integration	Strengthening extension, institutions, training, community-based knowledge sharing.	Moderate	This connects crop residues and livestock. If designed well, it can support improved feeding alternatives for livestock.

Table 4: Investment dimensions under the CSAIP[COG1]

The financial indicators within the CSAIP provide important insight into the economic viability of methane-relevant agricultural interventions. The CSAIP uses indicators such as the Net Present Values (NPV), Return on Investment (ROI) and the Benefit Cost Ratio (BCR) as key indicators for appraisal.[27]

Across the CSAIP, many of the interventions with strong methane relevance record significantly improved NPV, ROI and BCR values under the Climate Smart Agriculture (CSA) scenario compared to the BAU scenario. For example, interventions linked to advisory systems, cereal-legume integration, rice water management, and climate-resilient livestock systems all record strong improvements in financial performance under CSA conditions. In some livestock-related interventions, BCR values increase from below 1 under BAU to above 1 under CSA, indicating that climate-smart approaches can transform economically weak systems into financially viable investments. These findings demonstrate that methane-sensitive interventions can strengthen agricultural productivity, improve resilience to climate stress, reduce long-term production risks, and enhance the overall economic performance of agricultural systems.

Beyond the evidence from the CSAIP, recent agronomic studies support the economic importance of methane-sensitive interventions. For example, Li et al. (2024) show that AWD maintained rice yields and produced about a 1.5% increase in rice yield and 42% reduction in methane emissions.[28] Global reviews of enteric methane mitigation show that strategies such as improved diets, better forage quality, and some feed additives reduce methane per unit of product and often increase milk or meat output per animal, improving farm economics.[29] The results therefore reinforce the argument that methane abatement in agriculture can serve both environmental and economic objectives simultaneously.

Investment Area	NPV (USD Million)		Return on Investment		Benefit Cost Ratio	
	BAU	CSA	BAU	CSA	BAU	CSA
1. Advisory Services and Information Systems	198.1	331	4.74	7.9	2.99	4.99
2. Integrated Water Resource Management for Rice	143.7	171.1	2.32	2.78	1.54	1.84
3. Cereal–Legume Integration	109	208.8	4.04	7.77	2.63	5.04

Table 5: Investment dimensions under the CSAIP

[27] The NPV measures the total net economic value created by a project after accounting for costs and the time value of money. The ROI measures the amount of economic return generated relative to the amount invested, effectively indicating how much value is generated per unit amount invested. The BCR, on the other hand, compares the total benefits generated by an intervention relative to its costs. A BCR greater than 1 indicates that the economic benefits outweigh the costs, while a value below 1 suggests that the intervention may not be economically viable under existing conditions.

[28] Li, L., Huang, Z., Mu, Y., Song, S., Zhang, Y., Tao, Y., & Nie, L. (2024). Alternate wetting and drying maintains rice yield and reduces global warming potential: A global meta-analysis. Field Crops Research, 318, 109603.

[29] Beauchemin, K. A., Ungerfeld, E. M., Abdalla, A. L., Alvarez, C., Arndt, C., Becquet, P., ... & Kebreab, E. (2022). Invited review: Current enteric methane mitigation options. Journal of Dairy Science, 105(12), 9297-9326.; Roques, S., Martinez-Fernandez, G., Ramayo-Caldas, Y., Popova, M., Denman, S., Meale, S. J., & Morgavi, D. P. (2024). Recent advances in enteric methane mitigation and the long road to sustainable ruminant production. Annual Review of Animal Biosciences, 12(1), 321-343.

Investment Area	NPV (USD Million)		Return on Investment		Benefit Cost Ratio	
	BAU	CSA	BAU	CSA	BAU	CSA
4. Climate Smart Cocoa Production	188.8	231.3	4.15	5.1	2.72	3.33
5. Climate resilient poultry production	81.6	119.3	3.19	4.63	1.97	2.88
6. Climate resilient ruminant and genetic resource conservation	38.1	88.5	1.43	3.07	0.77	1.78
7. Sustainable fisheries and aquaculture	9.6	28.5	0.29	0.93	0.21	0.62
8. Diversified tree crops	204.2	217.6	8.24	8.79	5.30	5.64
9. Root and tubers-livestock integration	24.2	75.9	0.52	1.74	0.36	1.15

Table 6: Economic valuation of investment dimensions under the CSAIP

Source: World Bank (2022)[30]

Methane management embedded in climate action plans

Ghana's broader climate policy architecture is increasingly recognising methane as a critical climate and development challenge. While some frameworks focused heavily on CO_2 and adaptation needs, other commitments, such as the updated NDC and the National SLCP Action Plan, acknowledge methane's high warming potency and its central contribution to national emissions. However, the treatment of agriculture-linked methane within these frameworks remains uneven. Most national climate strategies reference agriculture mainly in relation to adaptation or productivity enhancement rather than methane mitigation.

A major turning point is the development of the Methane Roadmap Action Programme (M-RAP), currently underway with support from the Climate and Clean Air Coalition (CCAC). The M-RAP is expected to be Ghana's first comprehensive methane-specific implementation plan, explicitly covering agriculture, waste, and oil and gas. For agriculture, it is anticipated to outline clear abatement pathways including enteric fermentation interventions, enhanced manure management, and water management reforms in rice production. Once finalised, the M-RAP will provide an explicit roadmap for reducing agricultural methane, establishing targets, identifying priority measures, and aligning national investments with global methane pledges.

Table 6 maps how Ghana's existing climate policies address methane mitigation, with specific emphasis on the agriculture sector.

[30] World Bank. (2022). Climate-Smart Agriculture Investment Plan for Ghana. World Bank Group.

Policy document	How it generally addresses methane	Specific agriculture components	Strength of agric-methane integration
Ghana's Updated Nationally Determined Contribution (NDC), 2021	Recognises methane as a key GHG. Mentions methane recovery, biogas, and reduced biomass burning.	Agriculture is referenced mainly through climate-smart agriculture, sustainable land management, livestock productivity improvements.	Methane is acknowledged, but there is no quantified agric-methane mitigation pathway. There is also no explicit agric-methane target, but it is implied through CSA and livestock interventions.
National SLCP Action Plan (2016–2018)	Identifies methane as an important SLCP in Ghana. It also lists mitigation measures across waste, agriculture, biomass burning, oil & gas.	Contains agriculture-relevant SLCP measures such as improved livestock feeding, manure management, and reduced open burning.	Clearly identifies agriculture as a methane source and outlines sectoral actions, although it lacks deep implementation detail.
Ghana National Methane Roadmap (under development)	Specifically designed to map methane reductions across agriculture, waste and oil & gas. Focuses on achieving Paris and Global Methane Pledge commitments.	Expected to include enteric fermentation reduction pathways, manure management enhancement, rice water management (AWD).	This will be one of the strongest emerging pathways for agriculture methane reduction.
National Climate Change Policy (NCCP), 2013	Mentions methane broadly under GHG reduction but focuses on CO_2-heavy sectors.	Agriculture coverage is oriented towards adaptation and productivity.	Methane management is not central to agriculture strategy.
Ghana's Long-Term Low Emissions Development Strategy (LT-LEDS), 2021	Focuses on energy, land use, transport. Mentions methane mainly in waste and energy contexts.	Mentions CSA and livestock intensification, but methane is not quantified or directly addressed in agricultural systems.	Methane barely appears in relation to agriculture. They are implied through CSA and livestock production initiatives
National Adaptation Plan (NAP)	Methane not a major focus. The plan emphasises resilience across crops, livestock and water.	Highlights Agriculture adaptation measures (e.g., improved water management, improved feed systems).	Methane is not identified as a mitigation target under agriculture.

Table 7: Agriculture methane management embedded in climate action policies in Ghana

Challenges in Methane Abatement Practices in Ghanaian Agriculture

Beyond climate goals, reducing methane emissions is imperative for improving farm productivity and sustainability. However, implementing methane-reducing practices on the ground faces numerous practical challenges. This section examines those challenges in the Ghanaian context, drawing on farmer perspectives, project evaluations, academic research, and government/donor reports. Key themes include farmer awareness, extension approaches, feasibility in smallholder systems, cost and financing, infrastructural gaps, farmer perceptions, extension capacity, and the status of adoption of methane-abating interventions.

Limited Awareness and Understanding of Methane-Reducing Practices

Awareness of methane-reducing agricultural practices remains limited among Ghanaian farmers, even as training programmes on AWD, zero-burning and improved manure management expand. Stakeholder interactions indicates that although some farmers have been introduced to these innovations, many have a limited understanding of how these practices reduce methane and the climate rationale behind them. Demonstration fields and local-language training are essential, but farmers commonly adopt practices only when they see direct productivity gains, not because they understand the climate rationale. This highlights a critical concern that methane mitigation messaging rarely resonates unless it is explicitly tied to yield improvements or reduced labour burdens.

Additionally, many farmers still hold beliefs that run counter to mitigation practices. For example, the long-standing narrative that rice must be kept continuously flooded to ensure good yields remains deeply embedded among rice farmers. Hence the idea of intermittently drying fields is usually perceived as counterintuitive and even risky.[31] Similarly, livestock keepers traditionally rely on natural grazing and basic husbandry, without the awareness that poor feed quality leads to higher methane emissions and lower productivity. Consequently, most farmers have not been consciously implementing methane-reducing practices, because they often do not recognize these practices or their co-benefits.

Bridging this awareness deficit remains a foundational requirement. Unless farmers clearly understand how mitigation practices work, why they matter, and how they also improve farm outputs, large-scale adoption will remain slow and uneven.

[31] Mensah P.K., Amankwah-Yeboah, P., Yeboah, S., Sakyiamah, B., Agyemang, E.B. (2023). Mitigating climate change in rice production: rice farmers introduced to the alternate wetting and drying technology. Council for Scientific and Industrial Research – Crop Research Institute. Available at Ministry of Food and Agriculture (2025). Feed Ghana Programme (FGP). A Four-Year Agricultural Transformation. Programme (2025 - 2028)

Feasibility of methane management practices in smallholder farming systems

Even when awareness exists, the feasibility of methane-reducing practices is constrained by Ghana's predominantly smallholder, low-input and extensive farming systems. For example, Rice production in Ghana occurs under three main systems: rain-fed upland, rain-fed lowland, and irrigated production. Among these, rain-fed lowland systems dominate, accounting for over 78% of the total harvested rice area.[32] This production structure has important implications for methane mitigation options in rice cultivation. In these systems, farmers generally lack the irrigation and drainage control required to implement controlled AWD, limiting its feasibility outside formal irrigation schemes.

Similarly, Ghana's livestock sector is largely extensive, where cattle, goats, and sheep graze on open rangelands or fallow fields, and housing is rudimentary.[33] Collecting manure for centralized management or biodigesters is therefore difficult when animals roam freely, with much of the dung left dispersed across grazing areas. Extensive grazing systems also mean that farmers often rely on natural pasture and crop residues rather than cultivated forages or formulated feeds. Although experts increasingly advocate a gradual shift toward improved forage systems, including the cultivation of higher-quality fodder such as elephant grass,[34] such transitions require additional financing, and technical support that may not be readily available to many smallholders.

As a result, methane-reduction strategies in extensive livestock systems must consider the realities of the extensive farming context. It therefore requires locally adapted improvements in feed quality, grazing management and decentralised extension support that align realistically with existing production systems.

Resource and Input Constraints

Adoption of methane-reducing practices in Ghana's agriculture sector is significantly constrained by resource and infrastructure limitations. Interactions with stakeholders revealed that many farmers lack basic infrastructure required for effective methane management. In rice systems, the absence of simple water-control structures such as irrigation valves, bunds, and field-levelling tools limits the practical application of AWD schemes, even where farmers have been trained. In livestock systems, the lack of manure storage sheds, composting pits, or biogas units prevents farmers from managing manure in ways that reduce anaerobic decomposition and methane release.

As already noted, feed quality constrains methane management in livestock production. Limited access to improved forage and feed resources, particularly during the dry season, leads to low-quality diets that increase enteric methane emissions per unit of output. Without reliable feed

[32] Ministry of Food and Agriculture. (2009). National Rice Development Strategy (NRDS) (Draft). Government of Ghana & JICA. https://www.jica.go.jp/Resource/english/our_work/thematic_issues/agricultural/pdf/ghana_en.pdf

[33] African Development Bank (2001). Livestock Development Project, Ghana; Achaglinkame, M. A., Dari, L., & Mörlein, D. (2023). A review of dairy production and utilization in Ghana and Benin. Discover Food, 3(1), 13.; United States Department of Agriculture (2023). Ghana Livestock Voluntary 2023.

[34] Incoom, L. D. N. G. (2025). Animal nutrition expert calls for improved feed strategies to cut emissions and boost livestock production. GBC Ghana Online. Available at https://www.gbcghanaonline.com/general/nutrition-expert-ansah/2025/

supply chains or support for forage production and conservation, efforts to reduce methane through improved feeding are difficult to sustain, even when farmers recognise their potential benefits.

These farm-level challenges are compounded by systemic weaknesses in agricultural support services, particularly extension delivery. Evidence from the literature suggests wide variation in reported extension agent-to-farmer ratios in Ghana, ranging from approximately 1:700[35] to as high as 1:1500.[36] Regardless of the precise figure, these ratios remain far above the FAO's recommended benchmark of one extension officer to 400 farmers. Limited extension coverage constrains farmers' ability to understand, correctly apply, and sustain methane-reducing practices such as AWD timing, improved feeding regimes, and manure handling.

Financial constraints intensify these challenges

The adoption of methane-reducing practices in Ghana's agriculture sector hinges critically on who bears the cost of implementation. Most of these interventions require upfront investments in infrastructure, labour, inputs, or technical support. Without external assistance, smallholders are unlikely to adopt them at scale.

In practice, Ghana's methane mitigation efforts in agriculture have been significantly supported through international climate finance and bilateral cooperation arrangements. A notable example is the Ghana–Switzerland cooperative approach under Article 6 of the Paris Agreement, which supports the scale-up of climate-smart rice production practices such as AWD schemes. The initiative is linked to a broader USD 42 million pay-for-results collaboration between the Swiss Government and UNDP aimed at supporting climate mitigation projects in developing countries.[37] This initiative demonstrates how international climate finance can unlock large-scale mitigation action in Ghana's agriculture sector. However, while such programme-level financing is critical, there remains considerable scope to expand and diversify financing mechanisms that directly support farm-level investments. This is particularly essential for smallholder producers who lack the capital to invest in water-control infrastructure, manure management facilities, or improved feeding systems.

Similar concerns exist in the livestock sector. Enhancing feed quality imposes both financial and labour costs on farmers. Studies in Northern Ghana consistently show low adoption of improved feeding because smallholders operate under severe liquidity constraints and prioritise short-term survival over long-term productivity investments.[38] Additionally, the upfront resource requirements act as strong disincentives. This is why several Ghanaian agricultural researchers argue that public programmes and targeted incentives are essential to strengthen feed systems and improve methane-efficient livestock productivity.[39] Without such support, the financial burden remains with farmers, and adoption rates remain extremely low.

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Farmer Perceptions: Labour, Productivity, and Risk Trade-offs

Farmer perceptions strongly shape the adoption of methane-reducing agricultural practices in Ghana. Many climate-smart interventions require more deliberate management, and farmers often equate this with increased labour. For example, AWD require frequent monitoring of water levels, which some smallholders view as more stressful compared to continuous flooding.[40] Similar concerns appear in livestock systems, where improved feeding is seen as labour intensive compared to free grazing. Unless farmers perceive clear benefits, these practices are often dismissed as excessive labour.

These perceptions matter because they influence whether innovations move beyond pilot projects into large scale adoption. Where farmers perceive higher labour, risk or unclear benefits, uptake is slow even when the climate rationale is strong as they generally prioritise labour savings and immediate productivity gains. Hence methane-reducing practices are most likely to be adopted when framed and demonstrated as improving yields, reducing water stress or cutting long-term production costs. This underscores the need for adaptation and mitigation programmes to align climate goals with the lived realities of smallholder farming systems.

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Conclusion

Methane management in Ghana's agriculture sector is essential for emissions reduction and for strengthening the productivity and resilience of the country's food systems. National inventories consistently show that agriculture a key source of methane emissions, driven primarily by livestock, manure systems and rice cultivation.

Ghana does not lack technical solutions for methane abatement. Extensive research[1] and demonstration projects have identified proven interventions that can significantly reduce emissions while improving yields. Additionally, the country does not suffer from a policy vacuum. Agriculture-related policies contain embedded methane-relevant practices, even when methane is not explicitly named. This implicit presence of methane-reducing measures across existing policies highlights the natural alignment between productivity goals and mitigation outcomes. The forthcoming Methane Reduction Action Plan (M-RAP) provides an opportunity to consolidate these scattered efforts by articulating a dedicated national strategy that elevates methane within Ghana's climate and agricultural agenda.

However, as with many climate ambitions, implementation remains the decisive challenge. Farmer-level realities shape what is feasible in practice. Without addressing these constraints, methane interventions risk remaining pilot-bound rather than system-wide. Financing is another barrier as most methane-focused initiatives to date have depended on donor support, underscoring the need for long-term public investment and stronger private-sector engagement. Successfully curtailing these practical obstacles will bring Ghana closer to a credible pathway of sustained methane reductions in agriculture. The study identifies the following recommended actions:

1. **Strengthen agricultural extension and farmer support systems for methane-sensitive agriculture:** Effective methane mitigation in agriculture will depend heavily on the strength of Ghana's extension and farmer support systems. Government should strengthen extension capacity through improved staffing, technical training, logistical support, and the integration of methane-sensitive practices into routine agricultural advisory services. Extension services should prioritise practical demonstrations, farmer field schools, peer-learning approaches, and continuous engagement tailored to the realities of Ghana's smallholder farming systems. For rice farmers, this means focusing AWD training primarily on irrigated and semi-controlled schemes where water levels can be actively managed while promoting more practical and context-appropriate water management improvements in rain-fed lowland systems. In livestock systems, extension efforts should prioritise feasible improvements in feeding efficiency, grazing management, and animal productivity within extensive production systems.

2. **Link methane mitigation to productivity and resilience outcomes:** Limited uptake of methane-reducing practices reflects less on resistance to climate action and more on farmers' rational prioritisation of yield stability, labour efficiency, and risk management.

Knowledge and awareness initiatives should therefore explicitly link methane reduction to outcomes that matter most to farmers, including improved yields, better animal performance, water savings, and reduced vulnerability to climate variability. Messaging that centres methane purely as an environmental externality may be less likely to resonate in smallholder contexts where immediate livelihood concerns dominate decision-making. Positioning methane management as a pathway to productivity gains and resilience, rather than an added obligation, is essential for meaningful adoption.

3. **Provide cost-saving mechanisms and incentives to boost adoption:** Government and development partners should prioritise cost-sharing mechanisms that reflect farmers' liquidity constraints, including targeted subsidies for simple water-control structures, support for community-level forage production, and incentives tied to productivity improvements rather than emissions metrics alone. While donor-supported programmes such as Article 6 AWD initiatives provide an important entry point, long-term sustainability will depend on integrating methane-related investments into mainstream agricultural financing, extension programmes, and district-level development planning.

4. **Ensure long-term follow-through and institutional ownership of the M-RAP:** The M-RAP should not become a short-lived initiative. Government must anchor it within existing agricultural and climate governance structures by assigning clear institutional responsibilities and integrating methane indicators into national monitoring frameworks. Periodic progress reviews and budgeted implementation plans are critical for ensuring that M-RAP commitments translate into action.

5. **Decentralise methane action to reflect Ghana's diverse agricultural systems and governance structures:** National-level strategies such as the M-RAP must explicitly account for differences between irrigated and rain-fed rice systems, extensive and semi-intensive livestock production, and varying levels of infrastructure and market access. District Assemblies, which already play a central role in agricultural planning and extension delivery, should be actively integrated into methane action planning, implementation, and monitoring. Embedding methane-related interventions within district medium-term development plans and decentralised agricultural programmes would improve contextual relevance, ownership, and sustainability. Without such decentralisation, methane action risks remaining technically sound but operationally disconnected from the realities of local farming systems.

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