Methane emission mitigation in the agriculture sector

Background

Methane, a greenhouse gas with a warming potential more than 80 times higher than CO_2 over a 20-year time frame, is responsible for half a degree Celsius of warming to date.[1] Methane's concentration in the atmosphere has been increasing rapidly over the last 15 years.[2] Methane is also a precursor to additional pollutants such as tropospheric ozone, which has negative consequences on air quality, human health and wellbeing, and crop yields.

Human activity in three sectors account for almost all global methane emissions, with agriculture accounting for 40% of emissions, fossil fuels for 35%, and waste for 20%.[3] Agriculture methane emissions stem most significantly from enteric fermentation, alongside rice cultivation, manure management, and residue burning – generating 3,772 $MtCO_2e$ in 2010 and projected to rise to 5,198 $MtCO_2e$ in 2050 under business-as-usual.[4] Through ambitious mitigation activities, however, global agricultural methane emissions could fall by as much as 39% in 2050.[5]

Since the launch of the Global Methane Pledge (GMP) at COP26, more than 130 countries have committed to collectively reducing global methane emissions to 30% below 2020 levels by 2030. As of November, these countries represent roughly two-thirds of global GDP, more than 50% of global anthropogenic methane, and feature 13 of the top 20 largest methane emitters (Argentina, Australia, Bangladesh, Brazil, Canada, Ethiopia, Indonesia, Mexico, Nigeria, Pakistan, United States, Uzbekistan, and Vietnam). By adopting more of the technological or regulatory approaches described in this factsheet, countries can continue with their efforts to turn their ambitions into action by cutting global agricultural methane.

40% AGRICULTURE ACCOUNTS FOR 40% OF HUMAN ACTIVITY-LED METHANE EMISSIONS

39% GLOBAL AGRICULTURAL METHANE EMISSIONS COULD **FALL BY AS MUCH AS 39%** THROUGH MITIGATION ACTIVITIES

[1] IPCC AR6 WGI Summary for Policymakers Fig. 2 Figure SPM.2 in IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, et. al. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY,USA, pp. 3–32, doi:10.1017/9781009157896.001

[2] M Saunois et al 2016 Environ. Res. Lett. 11 120207 https://iopscience.iop.org/article/10.1088/1748-9326/11/12/120207

[3] UN Environment Programme. (2021, May 5). Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions. UNEP. https://www.unep.org/resources/report/global-methane-assessment-benefits-and-costs-mitigating-methane-emissions

[4] Searchinger et al. 2019. Creating a Sustainable Food Future. https://www.wri.org/research/creating-sustainable-food-future

[5] Searchinger et al. 2019. Creating a Sustainable Food Future. https://www.wri.org/research/creating-sustainable-food-future

Technological solutions for reducing agricultural methane emissions

Country-level action is critical to reducing global agricultural emissions and meeting the Global Methane Pledge. Effective mitigation measures in the sector depend, however, on several factors such as the region and its natural environment, socio-economic aspects, local nutrition patterns, as well as the production system (e.g., pasture vs. barns). For some solutions, accelerated and increased research is required to evaluate the feasibility and the cost of implementing them.

Solutions for mitigating methane emissions in the agriculture sector include:

- **Increasing the productivity and efficiency of ruminant livestock** (such as cattle, sheep, and goats) can provide more income for farmers while at the same time reducing enteric methane emissions per animal and/or per unit of milk or meat. Groups such as the Agriculture Innovation Mission for Climate and the Global Research Alliance on Agricultural Greenhouse Gases are helping to spur greater innovation and technology deployment.[6]
- **Reducing enteric fermentation.** Strategies that utilize feed additives to reduce enteric fermentation are in the early stages of research. However, potential additives include red seaweed, 3-nitrooxypropanol, nitrates, fatty acid supplementation, essential oils, ionophores and other feeds, drugs, or supplements.[7] In addition, vaccines that target the organisms that cause methanogenesis in cattle, manipulating microbiological communities in ruminant stomachs and selectively breeding animals that produce fewer emissions have been tested.
- **Improving manure management.** The separation of liquids from solids in manure to form two waste streams makes it possible to better direct nitrogen and phosphorus to fields that need them and reduces the costs of transporting manure to these fields.[8] Separation can be achieved by using "dry" systems—where farmers dry out manure before storage and using "wet" systems that separate liquids from solids. Experimenting with dry and wet storage strategies—such as using straw, plastic, and solid coverings for wet and dry manure, altering the bedding/litter material for dry manure, and diluting and using additives in wet manure can all be key in mitigating methane emissions from manure. Other effective manure management strategies may include adjusting the temperature of manure slurry and use of chemical additives, which have proven effective in reducing emissions during composting.[9] Finally, diverting manure from being discharged into streams to being discharged onto farm fields avoids pollution and sequesters carbon.
- **Capture and use of methane emissions.** Biodigesters can be used to capture emissions from manure and use them to generate energy at both large-scale and household operations however some safeguards would need to be put in place to ensure methane leakage does not occur.[10]
- **Rice management strategies such as accelerating rice yield growth, removing rice straw from flooded fields, reducing flood periods, and breeding lower-methane rice can be effective in reducing methane emissions from rice production.**[11] Furthermore, improved management of water—including a single midseason water drawdown, the Alternate Wet-Dry method, non-water-intensive aerobic rice production, and dry seeding (as opposed to wet seeding) can lower rice production emissions. Methane reductions can also be achieved by plastic film mulching, rice modification (modified using a barley gene), and efficient fertilizer management (or using alternatives to urea fertilizer such as ammonium sulfate fertilizer). Furthermore, composting rice straw rather than adding it to flooded fields can aid in the avoidance of methane emissions from rice production.

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6 Monaco et al. 2021. How Methane Emissions Contribute to Climate Change https://www.wri.org/insights/methane-gas-emissions-climate-change

7 Ross et al. 2019. NDC Enhancement: Opportunities in Agriculture https://www.wri.org/research/ndc-enhancement-opportunities-agriculture

8 Searchinger et al. 2019. Creating a Sustainable Food Future. https://www.wri.org/research/creating-sustainable-food-future

9 Searchinger et al. 2019. Creating a Sustainable Food Future. https://www.wri.org/research/creating-sustainable-food-future

10 Ross et al. 2019. NDC Enhancement: Opportunities in Agriculture https://www.wri.org/research/ndc-enhancement-opportunities-agriculture

11 Ross et al. 2019. NDC Enhancement: Opportunities in Agriculture https://www.wri.org/research/ndc-enhancement-opportunities-agriculture

Regulatory options to achieve ambitious methane reductions at the country-level

Countries can encourage the adoption of the aforementioned technological solutions by advancing various overarching regulatory and policy mechanisms. Some sectoral methane mitigation best practices that have been included in subnational and national regulations and policies are discussed below:

- **Governments should implement laws that make agricultural methane emissions measurement and reductions mandatory,** such as California's Senate Bill 605, which requires the California Air Resources Board to develop a short-lived climate pollutant strategy, or New Zealand's Climate Change Response (Zero Carbon) Amendment Act of 2019, which codifies a law-binding target of a 10% reduction in biogenic methane emissions as compared to 2017 levels by 2030 and a 24-47% reduction by 2050.
- **Incentive or subsidy-based policies can be used to motivate private sector actors to implement methane emissions reduction strategies.** Examples of these types of policies are the California Department of Food and Agriculture (CDFA) Dairy Digester Research and Development Program (DDRDP)--which is an incentive-based program that catalyzes the installation of dairy digesters through financial aid.
- **Adopt inspection systems to monitor digester leaks.** For manure management systems using digesters, particularly in developing countries, governments should require future use of digester technologies with lower leakage potential. In addition, governments should adopt inspection systems that use methane detectors to monitor leaks.
- **Using taxes to encourage shift to healthier and more sustainable diets.** Reducing ruminant meat consumption by the world's highest consumers of these foods is a particularly promising strategy to achieve GHG emissions targets. Taxes may provide the strongest and technically most plausible measures that governments could take to influence consumption patterns, although they can be politically challenging to introduce and require attention to making sure these policies are equitable. Available evidence suggests that food taxes imposed at the retail level on certain types of food could work in developed countries. Since around 2010, several countries have established taxes on foods and beverages based on health concerns (e.g., sugary soft drinks, candy, foods high in saturated fats)—including Barbados, Chile, Denmark, Finland, France, Hungary, Mexico, and local governments in the United States. Reviews of these kinds of efforts indicate a significant effect on consumption.[12]

Emission Scoping and enhanced MRV in Agriculture: a case study

More research is needed in assessing greenhouse gas emissions from livestock systems in developing countries, since current assessment practices are often based on industrial systems from high-income countries. This disregards the specific situation of millions of people worldwide who depend on extensive livestock production (PASTRES 2021). The Programme for Climate-Smart Livestock systems (PCSL), implemented in several African countries (Ethiopia, Kenya, Uganda among others) by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) together with the International Livestock Research Institute (ILRI) and the World Bank on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ) , for instance, supported the estimation of enteric methane emission factors for cattle in semi-arid areas of Kenya (Link).

The availability of Tier 2 emission factors for GHG reporting has been novel for the African livestock sector, as there is very little in situ data for these systems. The improvement in data enabled governments to report more accurately on their emissions reductions and establish a more enhanced MRV system, which form the basis for reporting on their Nationally Determined Contributions (NDCs) to the Paris Climate Agreement.

12 Searchinger et al. 2019. Creating a Sustainable Food Future. https://www.wri.org/research/creating-sustainable-food-future

Building Capacities

Through collaboration and shared knowledge, the identification and implementation of methane pollution solutions becomes faster, scalable, and accessible. **The following organizations have the expertise and capacities to support nations in their methane pathways.**

CATF CLEAN AIR TASK FORCE

CLIMATE & CLEAN AIR COALITION TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

IFC International Finance Corporation WORLD BANK GROUP

WORLD RESOURCES INSTITUTE