CLIMATE IMPACT

Consequences of an alternative emission metric

GWP* is an alternative emission metric that better represents the short-lived character of methane, but its application is not straightforward and can have a substantial impact on the design of mitigation policies in agriculture.

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Carbon dioxide (CO_2) is the main contributor to global warming, but other greenhouse gases (GHGs) such as methane (CH_4) and nitrous oxide (N_2O) also have an important role. Emission metrics are used to compare the effect of GHG species on climate impact. The 100-year Global Warming Potential (GWP100) is the most common metric and has so far been used in national reporting to the United Nations Framework Convention on Climate Change (UNFCCC) and in GHG-accounting standards for businesses. According to the most recent Intergovernmental Panel on Climate Change (IPCC) report[1], the GWP100 values of a molecule of non-fossil CH_4 and a molecule of N_2O are, respectively, 27 and 273 times stronger than that of a molecule of CO_2. Recent studies show that for short-lived GHGs such as methane, the GWP100 does not properly reflect the actual effect on temperature[2,3]. Methane has an average lifetime of 11.8 years[1], whereas long-lived gases such as CO_2 stay in the atmosphere for centuries and more. This means that stabilization of the CH_4 concentration in the atmosphere results in only limited additional warming after that period, and a decline in CH_4 emissions can even reduce warming. To better reflect this behaviour, an alternative metric, denoted GWP*, has been developed for short-lived GHGs. This metric is not based on the annual emission, but on the change in emission over time[3,4].

Now, writing in *Nature Food*, Pérez-Domínguez and colleagues[5] show the potential impact of the short-lived character of methane, based on GWP*, for a range of mitigation scenarios for agriculture. The alternative metric is especially relevant for agriculture, being the sector with the largest contribution to human-induced methane emissions[6]. These emissions are mainly produced by livestock, with enteric fermentation by ruminants and manure management as main emission sources[7]. The GWP* method shows that the short-term effect of methane is about four times higher than in the conventional GWP100 method, but is only a quarter of the conventional GWP100 in the long term. GWP100 can therefore be considered as a compromise between short-term and long-term impact.

Pérez-Domínguez and colleagues used an ensemble of three global economic land-use models (GLOBIOM, MAGNET and CAPRI) to simulate the effects of alternative valuations of methane (that is, short-term and long-term impact), different carbon prices and a diet shift towards lower animal protein consumption. They show that emission-accounting metrics have a significant impact on climate mitigation policy options, especially under stringent mitigation scenarios. Carbon pricing would reduce agricultural non-CO_2 emissions by up to 55% in 2070 compared with the business-as-usual scenario, and aggregate warming would by then be reduced to zero compared with +0.17 °C in the baseline. When focusing on the short-term effect of methane, the reduction in methane emissions would be larger, but with stronger impacts on the agricultural system. Dietary shifts can significantly contribute to climate stabilization and have a larger impact on agricultural production than carbon pricing.

Global methane emissions from livestock have been increasing over the last century[8] and are expected to increase further given the growing world population. Pérez-Domínguez and colleagues show that in the business-as-usual scenario, methane emissions from agriculture increase by more than 50% in the period 2010–2070. Emissions are increasing in developing regions (Africa, Asia and Latin America), but decreasing in most developed regions (Europe and North America) due to declining livestock numbers[8]. The use of GWP* would lead to strong diverging impacts. Countries that reduce livestock emissions could account for a cooling effect, whereas those with increasing livestock emissions will have a stronger contribution to global warming compared with the current valuation based on GWP100. However, the contribution to global warming of the historic increase in livestock production in developed countries would remain unaccounted for in their Nationally Determined Contributions (NDCs). This raises questions of equity and fairness[9]. A further complication is that the GWP* approach is based on the change in emissions over a certain period, which implies that both current and historic emission levels must be known. This opens the discussion as to whether this metric should be used at the national level for NDCs or for GHG emissions reporting at the product level.

Although the IPCC Sixth Assessment Report[1] recognizes this issue, it does not recommend the use of one specific emission metric, as the choice depends on the purposes for which gases or forcing agents are being compared. Thus, the choice of a metric is largely a political decision as it depends on which aspects of climate change are considered most important to a particular application or stakeholder over a given time horizon. Scenario studies, such as that presented by Pérez-Domínguez and colleagues, can inform this discussion by showing the impact of different metrics and mitigation policies.

The use of GWP* would be advantageous at the global level to better represent the impact of methane on global temperature and for the design of mitigation strategies, but not yet for reporting purposes at the national or product levels. For the design of mitigation strategies of agricultural methane emissions, the following actions are required: improve livestock efficiency in developing countries (that is, less methane per kilogram of livestock product); reduce consumption of livestock products in countries with high animal protein intake; apply (technical) mitigation measures (for example, anaerobic digestion, feed strategies, breeding and feed additives); and prevent trade-offs with long-lived GHGs (that is, no measures that reduce methane emissions, but increase CO_2 emissions).

If society puts more value on the long-term effect of methane, there is less necessity to reduce livestock production.

Contrastingly, for greater short-term impact on global temperature, the reduction of livestock consumption and production would be an effective mitigation strategy. ❐

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Competing interests

The author declares no competing interests.