**Supplementary Information**

**Summary of Country Reporting Requirements to the UNFCCC**

All countries that are party to the United Nations Framework Convention on Climate Change (UNFCCC) are required to provide national inventories of emissions and removals of anthropogenic greenhouse gases (GHGs). These inventories, typically within national communications (NC) reports submitted to the UNFCCC, establish the basis for monitoring the progress of individual countries in reducing emissions and for assessing the collective effort of countries to mitigate and adapt to climate change. The inventories provide self-reported estimates of anthropogenic GHGs. Countries produce the estimates using methods developed by the Intergovernmental Panel on Climate Change (IPCC) (e.g., IPCC 1996, 2006, 2019) and approved by the UNFCCC. The methods generally involve multiplying national data on an emissions-generating activity (i.e., activity data) by an emission factor that specifies GHG emissions per unit of activity. The IPCC uses a three-tiered approach for emission factors and activity data. Tier 1 factors primarily consist of country-level defaults, although contain low certainty. Tier 2 and 3 factors are more country- or region-specific and consequently have higher certainty compared to Tier 1 factors, yet they are demanding in terms of complexity and data requirements. Countries are encouraged to use higher tier factors to the extent possible, though use of higher tier emission factors may be constrained by national circumstances, specifically for low-and-middle-income countries (LMICs). Thus, reporting requirements differ for non-Annex I countries (predominantly LMICs) and Annex I countries (high-income countries) as their capacity, resources, responsibility for historical emissions, and vulnerability to climate change vary.

Non-Annex I countries are required to submit their first NC within three years of joining the Convention, and every four years thereafter (Decision 17/CP.8), provided that funding for the preparation of reports is available. Furthermore, non-Annex I countries should submit their first biennial update report by December 2014 and every two years thereafter. Non-Annex I countries should use the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Revised 1996 IPCC Guidelines) for estimating and reporting their carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) emissions at a minimum (IPCC 1996) and should use the global warming potentials (GWP) determined in the IPCC Second Assessment Report (SAR) (CH4 = 21; N2O = 310) based on a 100-year time scale if wishing to represent aggregated emissions in CO2 equivalence (CO2e). For non-Annex I countries we collected this data from countries’ GHG inventory tables in their NC or biennial update report, whichever was most recent.

Annex I countries are required to (i) submit their NC to the secretariat every four years (decision 2/CP.17) with their seventh NC submitted by 1 January 2018, however, they must (i) submit annual inventories in common reporting format tables and national inventory reports with 1990 as the base year for the estimation and reporting of inventories (Decision 24/CP.19), (ii) cover emissions and removals of direct GHGs (CO2, CH4, N2O, perfluorocarbons, hydrofluorocarbons, sulphur hexafluoride and nitrogen trifluoride) from five sectors (energy; industrial processes and product use; agriculture; land use, land-use change and forestry (LULUCF); and waste), (iii) use the methodologies provided in the 2006 IPCC Guidelines for National Greenhouse Gas inventories (2006 IPCC Guidelines), and (iv) use GWP from the IPCC Fourth Assessment Report (AR4) (CH4 = 25; N2O = 298) prescribed in decision 24/CP.19. All Annex I GHG data was extracted from common reporting format tables as they contained the most recent inventory.

With respect to LULUCF sector, key differences exist between reporting with Revised 1996 or 2006 Guidelines. The 1996 IPCC Guidelines for GHG accounting separate agriculture and LULUCF. The 2006 IPCC guidelines (required to be used after 2015 by Annex I countries) linked agriculture and LULUCF in one category known as Agriculture, Forestry and Other Land Use (AFOLU). However, in terms of reporting with common reporting format tables, Annex I national inventories will continue to have two separate chapters for Agriculture and LULUCF beyond 2015 (Decision 24/CP.19). The difference between agriculture and LULUCF is mainly that the former contains almost exclusively non-CO2 emissions from production processes, whereas LULUCF contains mostly CO2 emissions/removals. Hence, soil carbon is not considered within the Agriculture sector but rather under the Cropland and Grassland land use classes that are part of LULUCF.

**Supplementary Tables and Figures**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Table S1:** Ranking of top 10 agricultural emitters from the UNFCCC inventory by (i) total emissions, (ii) percentage of total gross emissions, and (iii) emissions per capita based in 2018 using GWPs from AR5. U.S.A. = United States of America. U.R. = United Republic. | | | | | | |
| **Rank** | **Agricultural emissions *(megatons per year)*** | | **Agricultural emissions as percentage of national emissions** | | **Agricultural emissions per capita *(metric ton)*** | |
| *Country* | *CO2e* | *Country* | *%* | *Country* | *CO2e* |
| **1** | China | 932.9 | Vanuatu | 87.4 | New Zealand | 8.7 |
| **2** | U.S.A. | 611.2 | Chad | 83.3 | Uruguay | 8.1 |
| **3** | Brazil | 506.9 | Rwanda | 82.7 | Mongolia | 6.3 |
| **4** | India | 493.7 | Burkina Faso | 81.9 | Paraguay | 4.6 |
| **5** | Pakistan | 173.5 | Guinea | 80.6 | Ireland | 4.4 |
| **6** | Tanzania | 172.5 | Uruguay | 74.9 | Guinea | 3.4 |
| **7** | Indonesia | 122.3 | Cameroon | 73.6 | Namibia | 3.4 |
| **8** | Argentina | 116.1 | Bhutan | 66.2 | U.R. of Tanzania | 3.1 |
| **9** | Russia | 111.1 | Mauritania | 65.9 | Mali | 3.0 |
| **10** | Mexico | 101.6 | Sudan | 64.8 | Australia | 2.9 |



**Figure S1:** Latest year of GHG inventory data submitted by non-Annex I countries (via NCs or BURs) to the UNFCCC. Decision 2/CP.17, created in March 2012, states “that non-Annex I Parties, consistent with their capabilities and the level of support provided for reporting, should submit their first biennial update report by December 2014; the least developed country Parties and small island developing States may submit biennial update reports at their discretion.”

Diagram

Description automatically generated

**Figure S2:** Annual national agricultural emissions (left) and associated top 10 emitters (right) converted to CO2e (CH4 GWP= 28; N2O GWP = 265) for (a) UNFCCC, (b) FAOSTAT, (c) WRI-CAIT and (d) EDGAR GHG inventories. Grey countries = no NC or data.