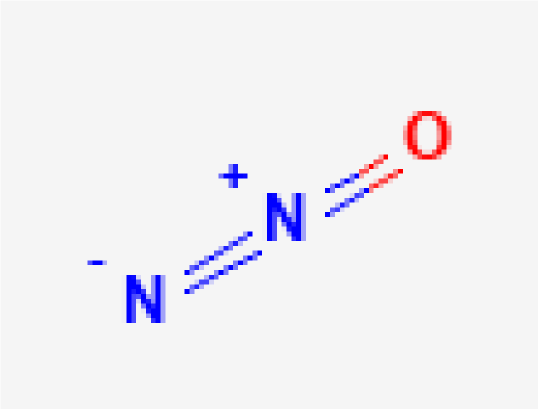
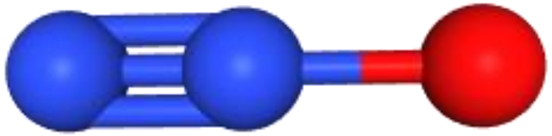


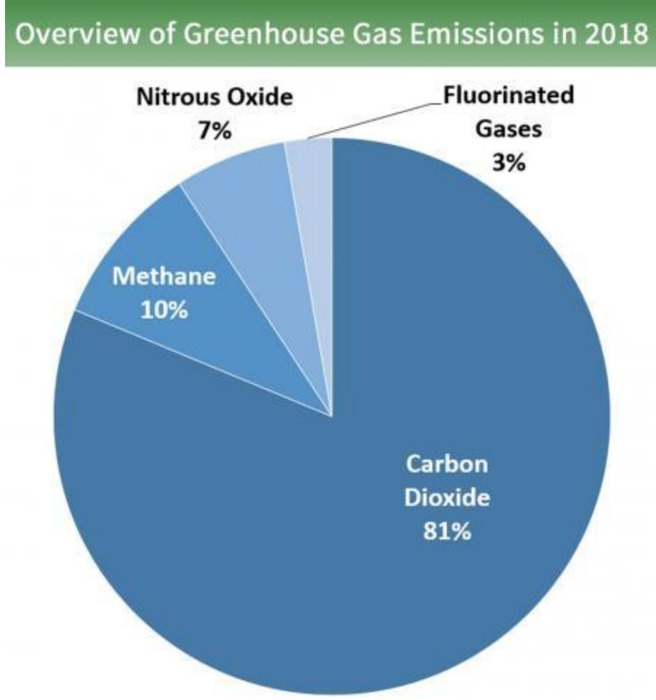
Nitrous oxide (N_20) emission

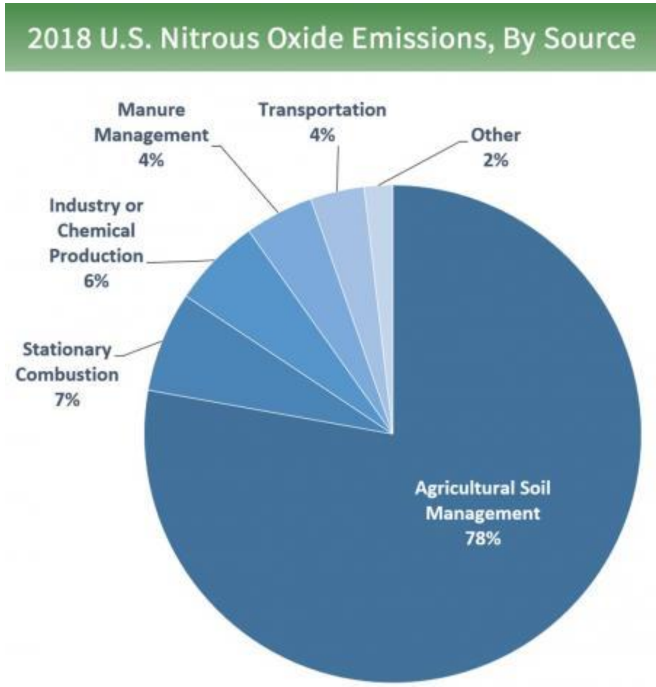
Zhenqi Luo   2020.10



a long-lived greenhouse gas

- an extremely potent greenhouse gas:
  - Lifetime in Atmosphere: 114 years
  - Global Warming Potential (100-year): 298 (IPCC, 2007)
- sources:
  - Agriculture (US: 78%, Global: ~22%):
    - Soil management: fertilizer and crop
    - Manure management
    - Agricultural burning
  - Fuel Combustion
  - Industry: byproduct (e.g. production of nitric acid)
  - Waste: during nitrification and denitrification of the nitrogen present
  - Natural: bacteria breaking down nitrogen in soils and the oceans



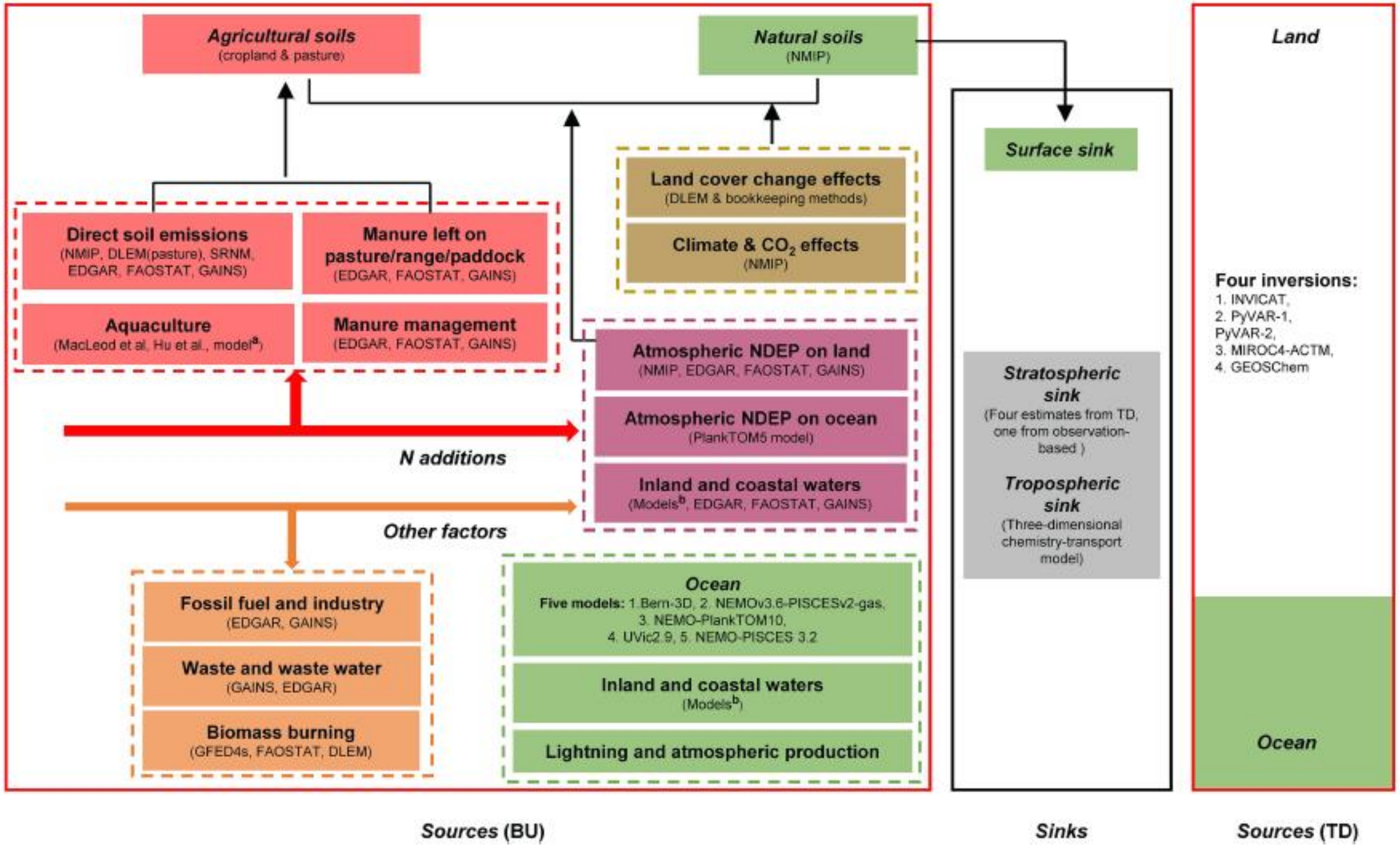


(EPA)

global nitrous oxide sources

Simple introduction

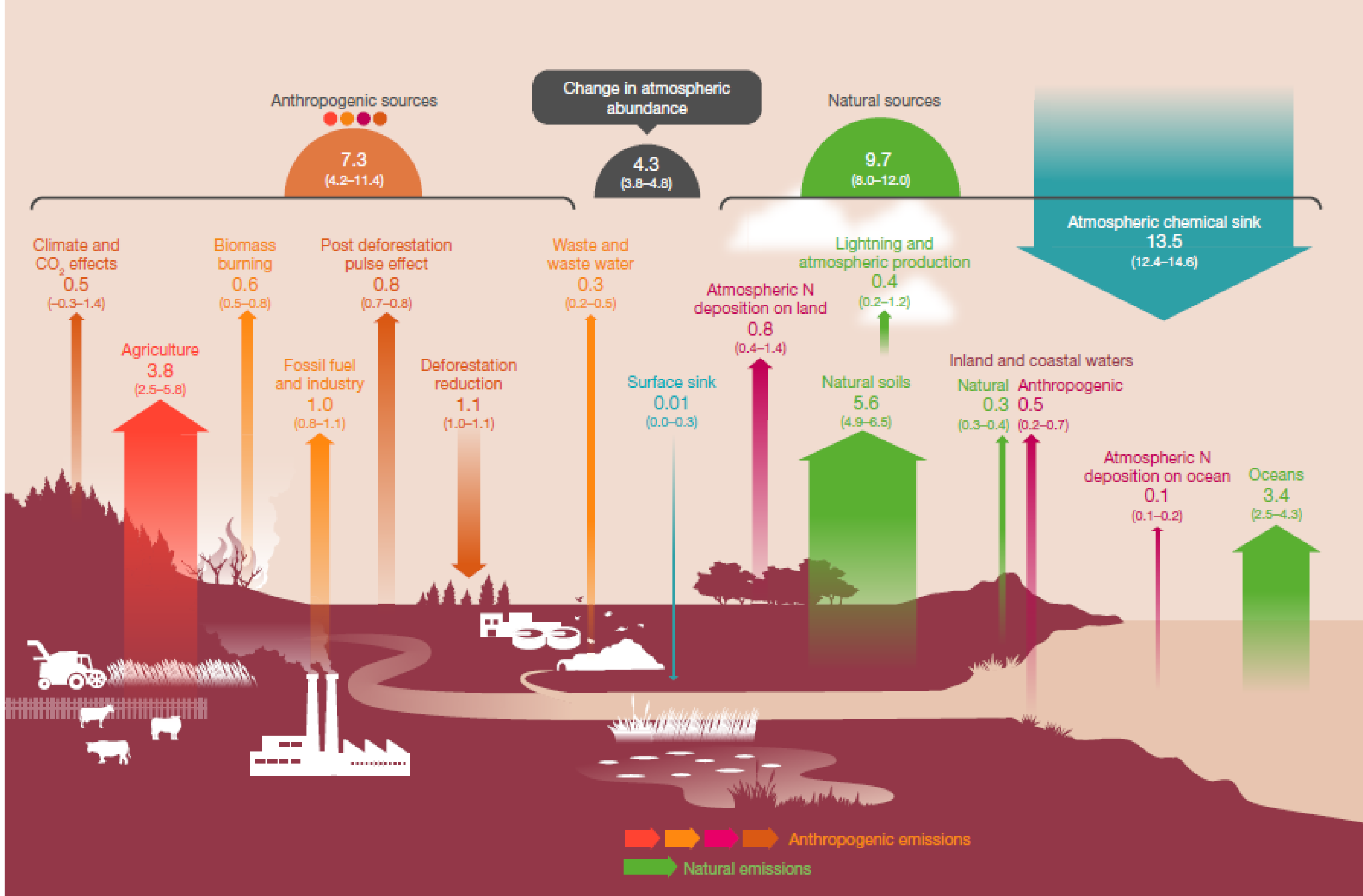
- A reconciling framework: constructed 43 flux estimates:
  - 30 bottom-up (BU)
    - emission inventories
    - spatial extrapolation of field
    - flux measurements
    - nutrient budget modelling
    - process-based modelling
  - 5 top-down (TD)
    - measurements
    - inversions
  - 8 observation and modelling



(Tian et al., 2020)

global nitrous oxide sources

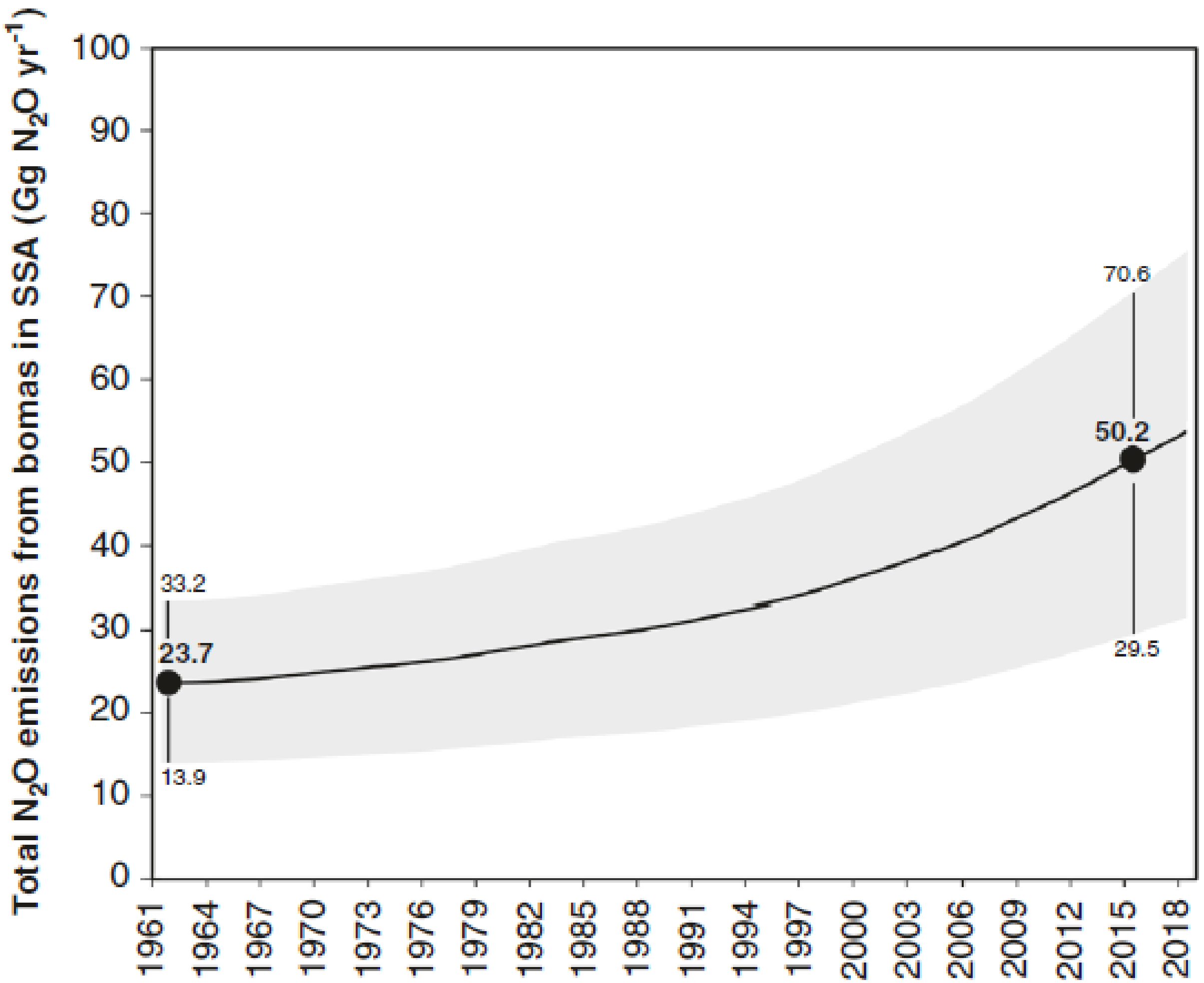
- The global N2O budget (2007–2016)
  - Natural sources (57%)
    - Natural soils (33%)
    - Lightning and atmospheric production (2%)
    - Waters (2%)
    - Oceans (20%)
  - perturbed fluxes from ecosystems (3%)
    - Climate change
    - CO2 effect
    - land cover change
  - agricultural sector (22%)
  - other direct anthropogenic sources (12%)
    - fossil fuel and industry (6%)
    - waste and waste water (2%)
    - biomass burning (4%)
  - indirect emissions from ecosystems (6%)
    - transport (5%)
    - deposition (1%)



(Tian et al., 2020)

N_2O emissions from bomas in drylands of Sub-Saharan Africa (SSA)

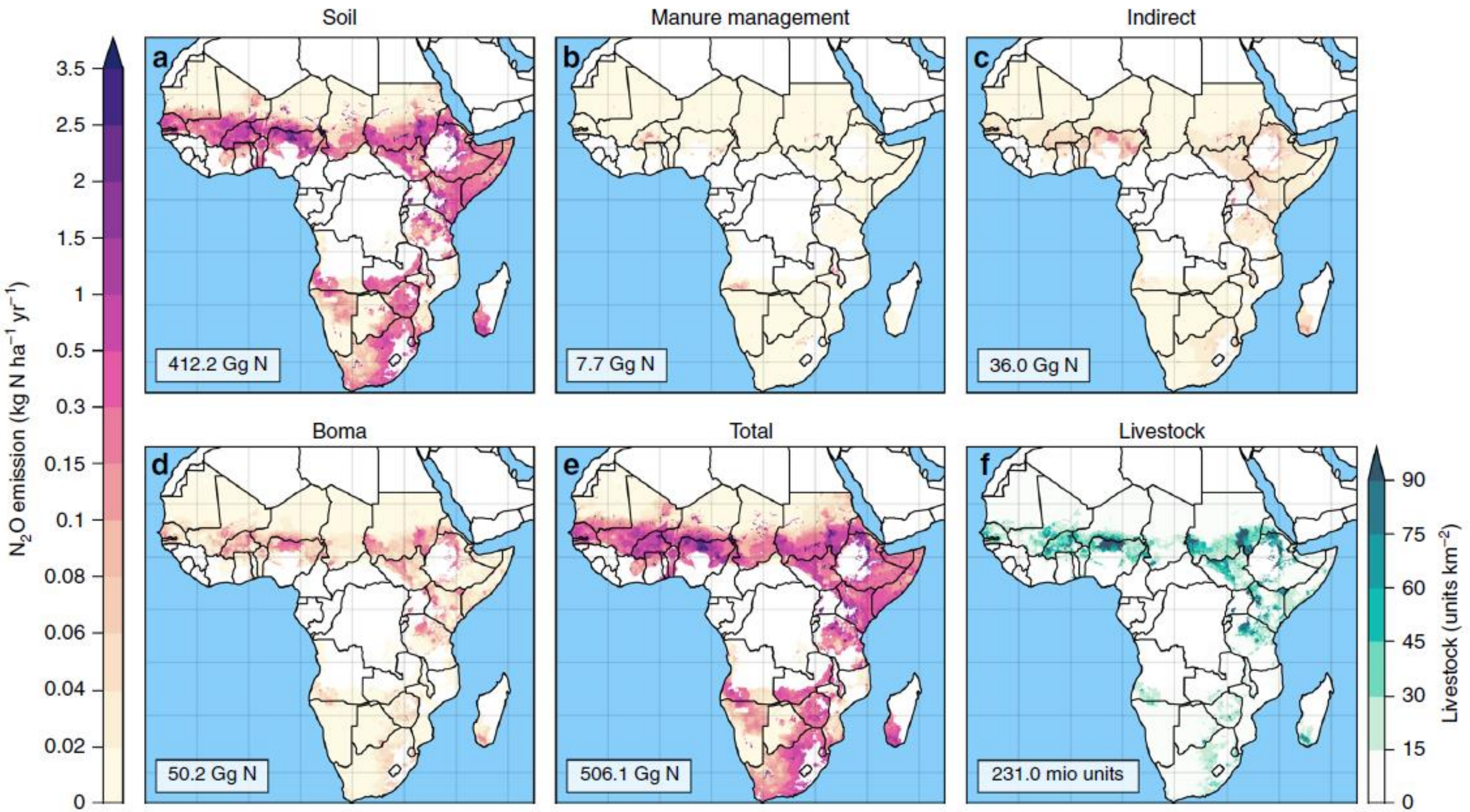
- Change in the source strength of abandoned bomas from 1961 to 2018
  - Step 1: total livestock numbers (TLN)
    - $TLN = \sum c + \frac{(s\times 0.1 + g\times 0.1)}{0.7}$
    - c, s, g: total number of cattle, sheep, goat
  - Step 2: boma use intensity (BUI):
    - $BUI = \frac{BAL\times NB\times FMB}{YB}$
    - BAL: boma area per livestock
    - NB: number of bomas in use at the same time
    - FMB: Fraction of bomas without use of manure
    - YB: years of boma use
  - Step 3: N_2O emission intensity (N_2O_int)
    - $N2O\_int = N_2O \times N_2O_{\_years} \times \frac{4}{28}$
    - N_2O: mean average annual N_2O flux from bomas
    - N_2O_years
    - $\frac{4}{28}$: conversion of N_2O-N to N_2O
  - Step 4: total N_2O emissions from bomas (N_2O_FB)
    - $\sum N_2O\_FB = TLN \times BUI \times N2O\_int$



(Butterbach-Bahl et al., 2020)

N_2O emissions from bomas in drylands of Sub-Saharan Africa (SSA)

- Sources of agricultural N_2O fluxes
  - EDGAR5
    - a: soil
    - b: manure management
    - c: indirect emission
  - in-situ measurements
    - d: total emissions from bomas (this study)
  - total agricultural N2O emissions
    - e=a + b + c + d
- livestock units: livestock density
  - $N = \sum cattle + \frac{(sheep \times 0.1 + goat \times 0.1)}{0.7}$



(Butterbach-Bahl et al., 2020)

Questions?