

Equation S1. Estimation of the area covered by urine patches

Urine patch area ($\text{m}^2/\text{cow}/\text{day}$) = daily urination volume (m^3) \div urine column (m) \times number of urination per day [15], assuming a urine column to be 9 mm [2].

Equation S2. Estimation of urinary nitrogen (UN) load

N load at urine patches (kg/ha) = UN excretion (kg) \div urine patch area (ha) [15],

where, UN excretion (kg) = urine volume (L) \times UN concentration (kg/L).