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Measurement report: Nitrogen isotope (δ^{15}N) signatures of ammonia emissions from livestock farming: implications for source apportionment of haze pollution

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Supporting Information

Supplementary Information Contents:

In total 4 pages including:

1.Text S1 (Pages)

2.Figures S1 to S4

3.Table S1 to S3

Supplementary Text

Text S1. Experimental Design and Sampling Methods for $\delta^{15}N$ in Livestock Farms.

Experimental Design.

The NH_3 emissions from livestock and poultry farming are collected from the NH_3 emitted by the livestock houses. The layer farms and fattening pig farms have enclosed livestock houses. To achieve effective ventilation, the chicken houses adopt a negative pressure longitudinal ventilation mode. Each layer house is equipped with 8 exhaust fans (Figure S1), with a single fan diameter of 138 cm and a fan speed of 1,400 $r \cdot min^{-1}$. During the sampling period, a maximum of 6 exhaust fans were operated simultaneously. Three air samplers were evenly distributed 2.0 meters from the exhaust outlets for sampling, with the air samplers positioned at a height of 1.6 meters. The fattening pig housing employs a negative pressure longitudinal ventilation system, with each building equipped with six exhaust fans. Each fan has a diameter of 110 cm, a rotational speed of 560 $r \cdot min^{-1}$, and a rated power of 1.1 kW (Figure S2). Sampling points are set at the exhaust outlets of the fattening pig housing, with three sampling points located 2 meters behind the center of the negative pressure fans at a height of 1.6 meters. The selected dairy cow shed for the study features an open structure, with four sampling points set along the aisle inside the shed. Each sampling point inside the shed is spaced 10 meters apart at a height of 1.6 meters (Figure S3).

Sampling method.

Use deionized water as the NH_3 absorption solution. Transfer 10 ml of unused clean deionized water

to a large bubble absorption bottle. Connect the absorption bottle to the air sampler using a 10 cm rubber hose. Set the gas sampling flow rate of the air sampler to 2 $L \cdot min^{-1}$ and perform a single sample collection for 60 minutes. After sampling, transfer the absorption solution to a 10 ml centrifuge tube and store it at -20°C for subsequent determination of $\delta^{15}N$.

Supplementary Figures

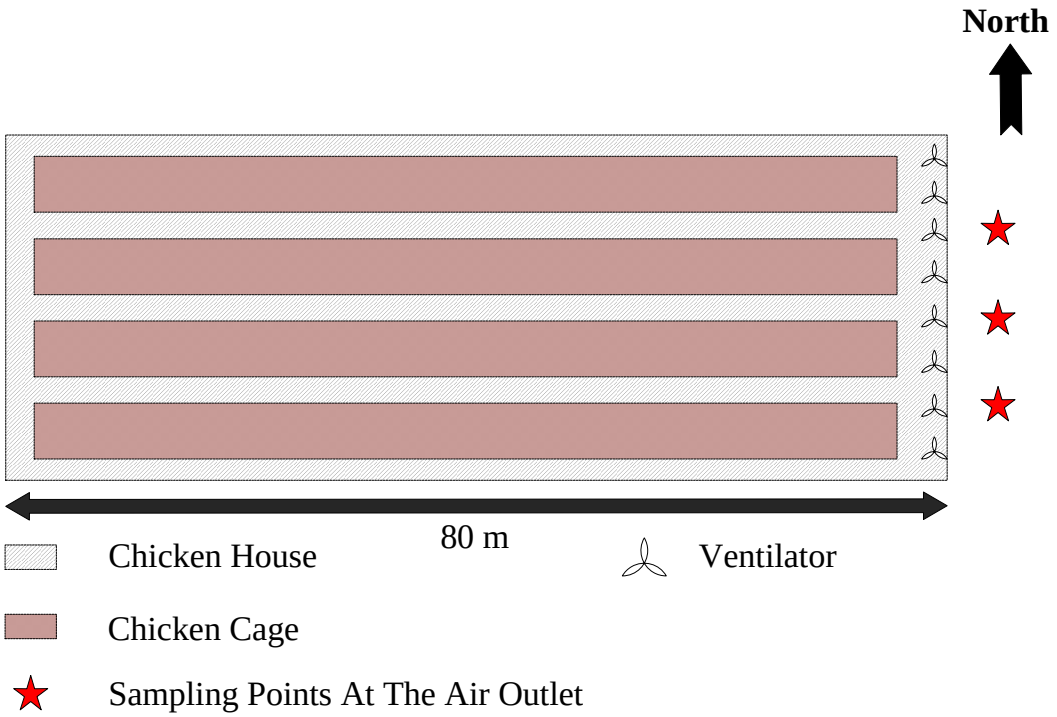

Figure S1. Structure of the intensive layer farm hen house, with the placement of atmospheric samplers at sampling points.

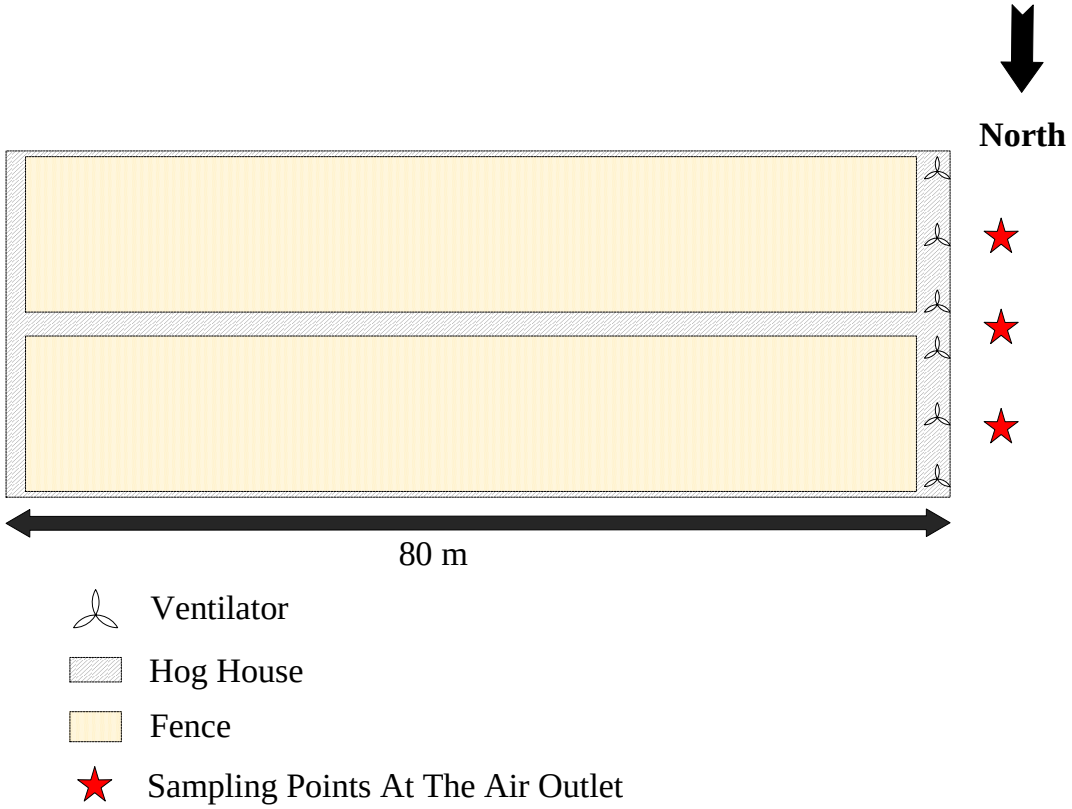

Figure S2. Structure of pig pens in an intensive fattening pig farm, with locations of atmospheric samplers for sampling points.

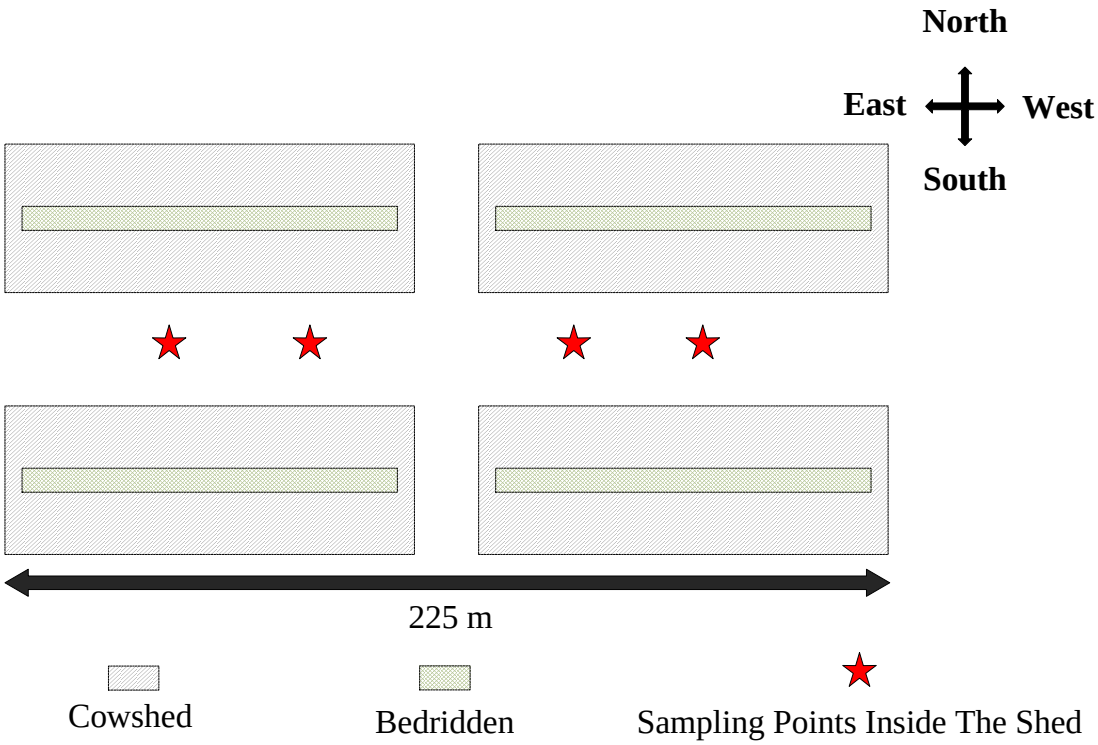

Figure S3. Structure of the dairy cow barn in an intensive dairy farm, showing the placement of atmospheric samplers at sampling points inside the barn.

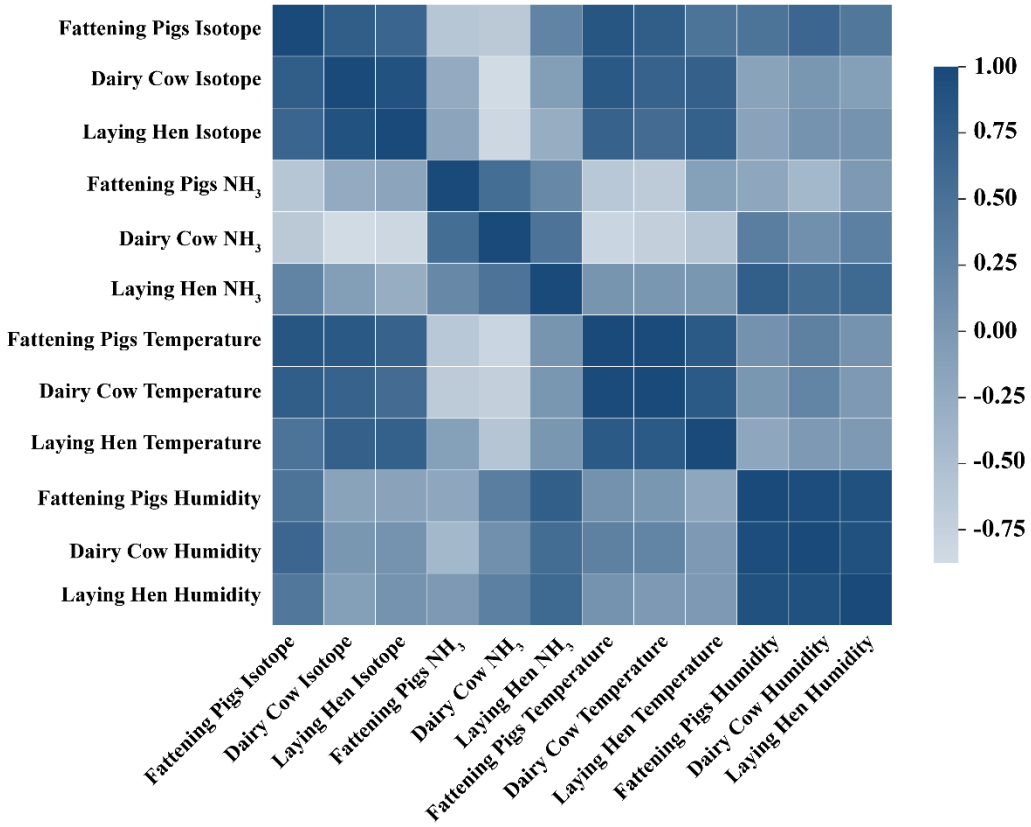

Figure S4. The correlation variations among NH_3 concentration, temperature, humidity, wind speed, and atmospheric pressure in different farms. Darker colors in the figure indicate higher correlations, while lighter colors represent weaker correlations.

Supplementary Table

Table S1 Variations in Temperature, Humidity and Ventilation Volume during Sampling at Fattening Pig Farms.

Fatting pig	Temperature (℃)	Humidity (%RH)	Ventilation Rate($m^3 \cdot h^{-1}$)
May.	29	57%	7612
Jun.	30	63%	8525
Sep.	31	70%	9439
Oct.	19	67%	8025
Nov.	17	64%	7918
Dec.	15	61%	8950

Table S2 Variations in Sampling Time, Temperature, Humidity and Ventilation

Volume at Layer Farms.

Laying hens	Temperature (℃)	Humidity (%RH)	Ventilation Rate($m^3 \cdot h^{-1}$)
May.	29	58%	27796
Jun.	30	65%	26812
Sep.	28	68%	29934
Oct.	18	65%	21212
Nov.	11	63%	3892

Table S3 Variations in temperature, humidity and ventilation rate during sampling at dairy farms.

Darry cow	Temperature (℃)	Humidity (%RH)	Ventilation Rate ($m^3 \cdot h^{-1}$)
May.	29	58%	5×10^6
Jun.	30	65%	2×10^6
Sep.	28	68%	3×10^6
Oct.	18	65%	5×10^6
Nov.	11	63%	6.0×10^6
Dec.	9	60%	2×10^6