Supplement for
Improved Daily Fertilizer-Induced Ammonia Emission Inventory for China by Combining Satellite Remote Sensing and Machine Learning

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Supplementary Text 1.

S1.1 Background Data for Daily NH_3 Emission Observations

For each record, corresponding background data were compiled from the literature, including meteorological conditions (daily mean air temperature, daily mean soil temperature, and daily total precipitation), soil properties (soil water content, clay content, pH, soil organic carbon content, total nitrogen content, and cation exchange capacity), and field management practices (nitrogen fertilizer application rate and application method).

S1.2 Data Preprocessing

Input features were preprocessed to ensure that they were properly formatted and scaled for model training. Specifically, two categorical features, namely days after fertilization and fertilizer placement, were encoded using one-hot encoding to prevent the model from imposing spurious ordinal or linear relationships on these variables (Lilhore et al., 2025). To address differences in scale and units across features, all numerical features were standardized using the z-score method. Standardization parameters were derived exclusively from the training set and subsequently applied to transform all dataset partitions, thereby preventing information leakage and ensuring unbiased model evaluation.

S1.3 BiLSTM–RF Model Prediction

We employed a bidirectional long short-term memory–random forest (BiLSTM–RF) ensemble algorithm incorporating an adaptive weighting mechanism that determined the weight coefficient of each sub-model according to its predictive performance on the validation set. This design combined the complementary strengths of deep sequential feature extraction and nonlinear feature partitioning. This ensemble approach was expected to yield more robust predictions and accurate predictions than either constituent model alone. The weight coefficients were determined as follows. First, the mean absolute error (MAE) of each model was computed over the validation set:

$$MAE_{BiLSTM} = \frac{1}{n}\sum_{i=1}^{n}\left|\hat{y}_{BiLSTM,i} - y_i\right| \quad (S1)$$

$$MAE_{RF} = \frac{1}{n}\sum_{i=1}^{n}\left|\hat{y}_{RF,i} - y_i\right| \quad (S2)$$

where n is the number of validation samples, y_i is the observed value of the i-th sample, and $\hat{y}_{BiLSTM,i}$ and $\hat{y}_{RF,i}$ are the predicted values from the BiLSTM and RF models, respectively. When the relative difference in MAE between the two models was less than 10%, both models were retained, and their weights were assigned in inverse proportion to their MAEs:

$$\omega_{BiLSTM} = \frac{MAE_{BiLSTM}}{MAE_{RF}+MAE_{BiLSTM}} \quad (S3)$$

$$\omega_{RF} = \frac{MAE_{RF}}{MAE_{RF}+MAE_{BiLSTM}} \quad (S4)$$

Otherwise, only the better performing model was retained for prediction:

$$(\omega_{BiLSTM}, \omega_{RF}) = \begin{cases}(0,1), if\ MAE_{RF} > MAE_{BiLSTM}\\(1,0), if\ MAE_{BiLSTM} > MAE_{RF}\end{cases} \quad (S5)$$

The final prediction was then obtained by weighted fusion:

$$\hat{y} = \omega_{BiLSTM} \cdot \hat{y}_{BiLSTM} + \omega_{RF} \cdot \hat{y}_{RF} \quad (S6)$$

where ω_{BiLSTM} and ω_{RF} are the fusion weights assigned to the BiLSTM and RF models, respectively, and $\hat{y}$ is the final prediction output.

S1.4 Hyperparameter Optimization Using the THRO Algorithm

To identify the optimal combination of hyperparameters, we used Tianji's Horse Racing Optimization (THRO, Wang et al., 2025b). Inspired by the ancient Chinese story of Tianji's horse racing, THRO employs a dual-population co-evolutionary mechanism and refines solutions iteratively through a competition phase, which involves dynamic pairing and updating, and a training phase, in which individuals learn from the optimal solution. The core update rule is expressed as follows:

$$X_i^{t+1} = p \cdot X_i^t + (1-p) \cdot X_{ref} + R \cdot \left(X_{ref} - X_i^t + p \cdot (\bar{x}_T - \bar{x}_K)\right) \cdot \alpha + \beta \quad (S7)$$

where X_i^t is the position of the i-th individual at iteration t, and X_{ref} is the reference position vector, selected as the position of the best, worst, or a randomly chosen individual depending on the competition scenario. The parameter $p = 1 - t/T_{max}$ decreases linearly with the iteration count, where t is the current iteration and T_{max} is the maximum number of iterations. The term R is a Levy flight-based perturbation vector defined as $R = Levy(d) \cdot B$, in which d is the problem dimensionality and B is a random dimension selection matrix. The vectors $\bar{x}_T$ and $\bar{x}_K$ denote the mean positions of the Tianji and King populations, respectively, and characterize the overall distribution of each population. Finally, α is a scaling coefficient, and β is a perturbation coefficient that enhances the ability of the algorithm to escape local optima. Owing to its adaptive search strategy, THRO achieves higher computational efficiency than conventional approaches such as grid search without compromising optimization performance. The population size and maximum number of iterations were set to 20 and 30, respectively, and the objective was to minimize the RMSE on the validation set.

The final model used the following key hyperparameters. The BiLSTM component had 94 hidden units and a dropout rate of 0.053. In the random forest component, the number of decision trees (NumTrees), the minimum leaf size (MinLeafSize), and the number of candidate predictors per split (NumPredictorsToSample) were 82, 1, and 7, respectively.

S1.5 Feature Importance Assessment

Feature importance was evaluated using the built-in function of the random forest component, which relies on out-of-bag (OOB) data. This function randomly permuted each predictor variable in turn and quantified its relative importance as the resulting increase in the OOB mean squared error (MSE), denoted IncMSE. For feature j, the importance score I_j is defined as:

$$I_j = \frac{1}{n_{tree}} \sum_{t=1}^{n_{tree}} \left(MSE_{t,j}^{per} - MSE_t^{ori}\right) \quad (S8)$$

where n_{tree} is the total number of decision trees in the random forest, t indexes the tth tree, $MSE_{t,j}^{per}$ is the OOB MSE of the tth tree after feature j has been randomly permuted, and MSE_t^{ori} is the OOB MSE of the tth tree evaluated on the original OOB data.

S1.6 Atmospheric Chemistry Model Configuration

Physical parameterizations included the Morrison double-moment microphysics scheme, the Grell-3D ensemble cumulus scheme, the Mellor–Yamada–Nakanishi–Niino (MYNN) Level 2.5 planetary boundary layer and MYNN surface layer schemes, the Noah land surface scheme, and the Rapid Radiative Transfer Model for General Circulation Models (RRTMG) radiation scheme. Chemistry was simulated with the Model for Ozone and Related Chemical Tracers (MOZART) mechanism, together with the Model for Simulating Aerosol Interactions and Chemistry (MOSAIC) aerosol module with four sectional bins and the Fast-J photolysis scheme. A 5-day spin-up period was applied, and model output was saved at hourly intervals. Meteorological initial and boundary conditions were derived from the National Centers for Environmental Prediction (NCEP) Final (FNL) reanalysis at a resolution of 1° × 1°, and chemical initial and boundary conditions were taken from the Community Atmosphere Model with Chemistry (CAM-Chem) global model of the National Center for Atmospheric Research (NCAR).

Supplementary Text 2.

S2.1 Performance of the BiLSTM–RF Model

The BiLSTM–RF model achieved an R^2 of 0.807 and an RMSE of 1.656 on the test set, indicating that it reliably captured daily variations in cropland NH_3 emissions. Feature importance analysis identified the nitrogen fertilizer application rate as the most influential predictor (IncMSE = 1.88), followed by precipitation (IncMSE = 1.42), temperature (IncMSE = 1.28), and soil pH (IncMSE = 1.24). These results suggest that NH_3 emissions following fertilizer application arise from a complex process jointly governed by field management practices, meteorological conditions, and soil properties.

S2.2 Uncertainty in NH_3 Emission Estimates

Provincial-scale NH_3 emission uncertainties were quantified for each crop type. For rice (Figure S4a), the largest uncertainties occurred in Hunan (94.66–209.70 Gg), Jiangxi (84.24–186.64 Gg), and Heilongjiang (66.60–147.56 Gg). Wheat emissions were most uncertain in Henan (51.62–114.36 Gg), Shandong (35.51–78.68 Gg), and Anhui (35.31–78.22 Gg) (Figure S4b). Among the provinces with maize emissions, Heilongjiang (102.59–227.28 Gg), Shandong (71.52–158.44 Gg), and Henan (71.40–158.18 Gg) showed the greatest uncertainties (Figure S4c).

Supplementary Figures.

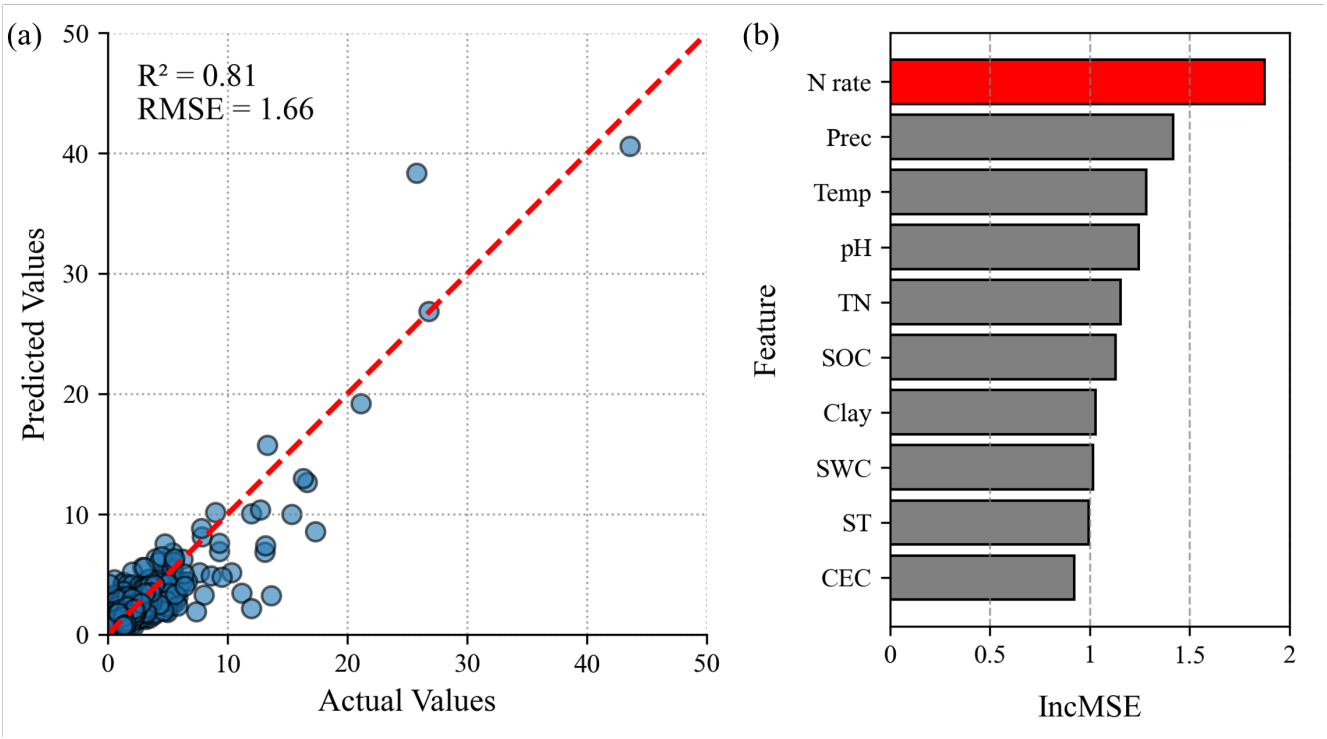


Figure S1: (a) Scatter plot of observed and predicted values on the test set; (b) Feature importance analysis.

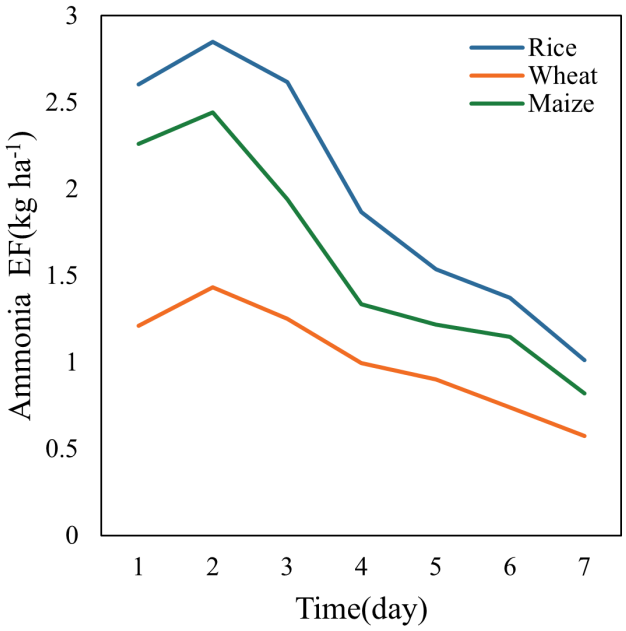


Figure S2: Mean NH_3 emission factor dynamics following fertilizer application for rice, wheat, and maize.

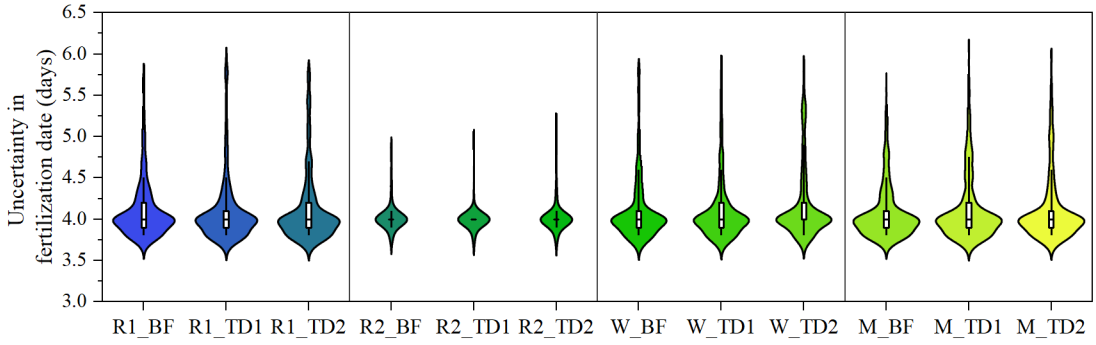


Figure S3: Statistical characteristics of uncertainty in fertilizer application dates for major crops in China. Outline width represents the density of the data distribution, and the internal box plot displays the median and interquartile range. X-axis abbreviations: R1, early-season and single-season rice (ERSR); R2, late-season rice (LR); W, wheat; M, maize; BF, basal fertilization; TD1/TD2, first/second topdressing.

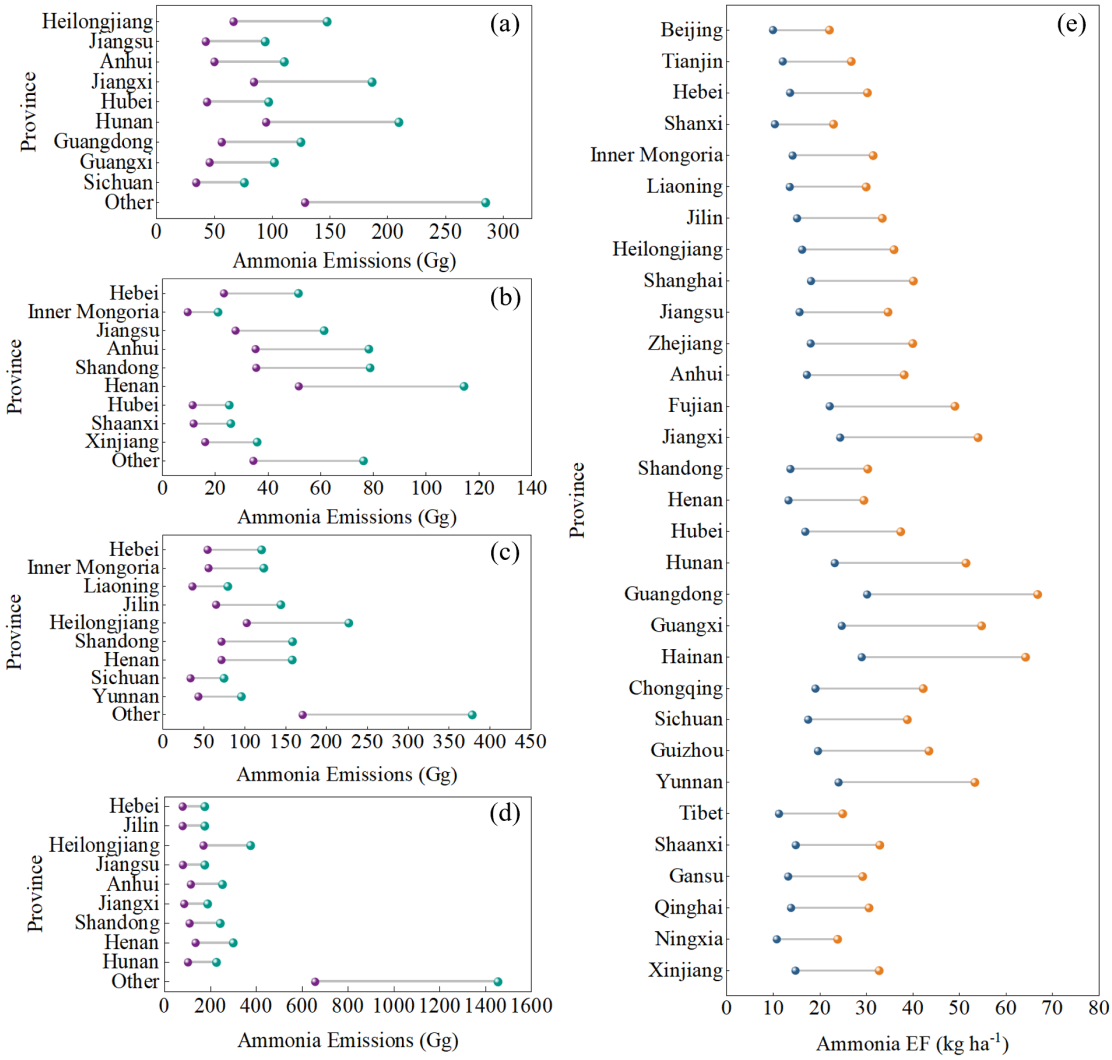


Figure S4: Provincial-scale uncertainty in NH_3 emissions and emission factors for major crops in China. Panels show the uncertainty ranges of provincial NH_3 emissions for rice (a), wheat (b), maize (c), and the sum of all three crops (d), as well as the uncertainty ranges of provincial emission factors (e).

Supplementary Tables.

Table S1: Field measurement sites for major crop NH_3 emissions in China.

Crop type	Lon	Lat	Crop type	Lon	Lat	Crop type	Lon	Lat
Rice	28.52	113.37	Wheat	28.69	112.9	Wheat	32.53	119.47
Rice	28.92	112.93	Wheat	28.88	113.8	Wheat	33	119
Rice	30.35	112.15	Wheat	28.92	111.5	Wheat	34.28	108.07
Rice	31.53	120.68	Wheat	28.93	112.93	Wheat	41.52	123.4
Rice	31.55	120.7	Wheat	28.97	112.75	Wheat	42.37	123.93
Rice	32.07	118.85	Wheat	29.28	113.1	Wheat	45.58	123.83
Rice	33.45	113.2	Wheat	29.95	115.55	Maize	24.58	102.53
Rice	34.13	113.8	Wheat	30.38	120.11	Maize	31.5	120.7
Rice	35	113.68	Wheat	30.38	112.48	Maize	33.45	113.2
Rice	35	113.72	Wheat	30.43	120.42	Maize	34.13	103.07
Rice	35.07	113.17	Wheat	30.45	116.31	Maize	34.28	108.07
Rice	36.15	117.15	Wheat	30.95	103.73	Maize	34.3	108.1
Rice	36.33	117.22	Wheat	31.02	119.05	Maize	35.2	107.67
Rice	38.13	115.07	Wheat	31.25	120.95	Maize	35.2	107.78
Rice	39.5	115.42	Wheat	31.28	119.9	Maize	36.15	117.15
Rice	39.71	115.82	Wheat	31.37	120.18	Maize	36.33	117.22
Wheat	20.03	110.32	Wheat	31.5	120.3	Maize	38.13	115.07
Wheat	23.13	113.33	Wheat	31.53	120.62	Maize	38.17	116.87
Wheat	23.35	115.9	Wheat	31.53	120.68	Maize	39.58	116.58
Wheat	25.88	100.17	Wheat	31.55	120.7	Maize	40.33	106.98
Wheat	26.02	100.05	Wheat	31.65	117.77	Maize	40.43	106.57
Wheat	28.18	113.1	Wheat	31.91	118.79	Maize	40.83	107.83
Wheat	28.32	113.82	Wheat	31.97	119.3	Maize	42.37	123.93
Wheat	28.43	113.05	Wheat	31.98	119.5	Maize	43.3	124.33
Wheat	28.5	116	Wheat	32.34	119.4			
Wheat	28.55	113.32	Wheat	32.42	120.1			

Table S2: Proportions of basal and topdressing fertilizer application for major crops across regions of China.

Region	Crops	Basal	Topdressing
North China	Rice	0.52	0.48
	Wheat	0.63	0.37
	Maize	0.42	0.58
Northeast China	Rice	0.60	0.40
	Wheat	0.65	0.35
	Maize	0.61	0.39
East China	Rice	0.51	0.49
	Wheat	0.62	0.38
	Maize	0.29	0.71
South China	Rice	0.47	0.49
	Wheat	0.50	0.50
	Maize	0.31	0.69
Southwest China	Rice	0.51	0.49
	Wheat	0.61	0.39
	Maize	0.39	0.61
Northwest China	Rice	0.54	0.49
	Wheat	0.81	0.19
	Maize	0.53	0.47

Note: The data in the table were established by Wang et al. (2008)

Table S3: Performance comparison of machine learning models evaluated in this study.

Model	R^2	RMSE
MLR	0.17	3.44
GAM	0.64	2.26
LSTM	0.5	2.67
LSBoost	0.69	2.09
XGBoost	0.75	1.91
BiLSTM-RF	0.81	1.66

Table S4: Web Links to Agricultural News Reports on Fertilization.

Crop	Application Method	prefecture-level city	URL
Rice	Basal	Harbin	https://finance.sina.com.cn/jjxw/2025-05-11/doc-inewcxhn4422883.shtml https://www.harbin.gov.cn/haerbin/c104697/202605/c01_1124654.shtml https://www.sohu.com/a/1020951285_100267014 https://m.thepaper.cn/baijiahao_12709070 https://news.sina.com.cn/zx/gj/2025-05-16/doc-inewttnz8575414.shtml https://www.news.cn/local/20260513/b7f4d192d0eb4ee59f946393593875f7/c.html
Rice	Basal	Jixi	https://www.news.cn/local/20260513/b7f4d192d0eb4ee59f946393593875f7/c.html https://www.toutiao.com/article/7641540143500771840/ https://www.news.cn/local/20260513/b7f4d192d0eb4ee59f946393593875f7/c.html https://www.news.cn/local/20260513/b7f4d192d0eb4ee59f946393593875f7/c.html
Rice	Basal	Shuangyashan	https://www.news.cn/local/20260513/b7f4d192d0eb4ee59f946393593875f7/c.html https://www.news.cn/local/20260513/b7f4d192d0eb4ee59f946393593875f7/c.html http://vip.people.com.cn/albumsDetail?aid=1802489 https://www.news.cn/local/20260513/b7f4d192d0eb4ee59f946393593875f7/c.html
Rice	Basal	Jiamusi	https://www.news.cn/local/20260513/b7f4d192d0eb4ee59f946393593875f7/c.html https://www.gov.cn/yaowen/tupian/202505/content_7023929.htm https://www.gov.cn/yaowen/tupian/202505/content_7023929.htm https://www.gov.cn/yaowen/tupian/202505/content_7023929.htm

Crop	Application Method	prefecture-level city	URL
Rice	Basal	Qiqihar	https://www.qqhr.gov.cn/qqhe/c100692/202605/c02_622564.shtml https://qqhr.gov.cn/qqhe/c100124/202405/c02_470027.shtml https://www.hlj.gov.cn/hljapp/c116058/202605/c00_31941457.shtml https://www.sohu.com/a/894990242_100267014
Rice	Basal	Suihua	https://www.news.cn/local/20260513/b7f4d192d0eb4ee59f946393593875f7/c.html https://www.hljqingan.gov.cn/qa/bmdt/202605/c12_233243.shtml
Rice	Basal	Hegang	https://www.news.cn/local/20260513/b7f4d192d0eb4ee59f946393593875f7/c.html
Rice	Basal	Daqing	https://sj.scpo.cn/detail/680893
Rice	Basal	Mudanjiang	https://www.news.cn/local/20260513/b7f4d192d0eb4ee59f946393593875f7/c.html
Rice	Basal	Nanjing	https://nyncj.nanjing.gov.cn/nygzdt/202606/t20260603_5851033.html https://www.toutiao.com/article/7514649928359117323/ https://yrd.huanqiu.com/article/4IHY9Ein358 https://nyncj.nanjing.gov.cn/nygzdt/202606/t20260608_5853283.html
Rice	Basal	Changzhou	http://vip.people.com.cn/albumsDetail?aid=1813185&pid=13288185 https://www.changzhou.gov.cn/ns_news/91174944861615 http://vip.people.com.cn/albumsDetail?aid=1437448 https://www.cfsn.cn/news/detail/269/252517.html https://www.cfsn.cn/news/detail/269/252517.html
Rice	Basal	Wuxi	https://www.wxrb.com/doc/2026/04/22/448076.shtml https://www.wuxi.gov.cn/doc/2024/06/23/4338772.shtml https://www.wxrb.com/doc/2024/04/27/344064.shtml
Rice	Basal	Huai'an	https://www.toutiao.com/article/7515373182414504484/ http://vip.people.com.cn/albumsDetail?aid=1816103&pid=13312636 http://vip.people.com.cn/albumsDetail?aid=1815622&pid=13308844 http://vip.people.com.cn/albumsDetail?aid=1553710&pid=11119659
Rice	Basal	Lianyungang	https://js.news.cn/20230623/92bce2da8c924af0a9cfa65d03c3ade7/c.html

Crop	Application Method	prefecture-level city	URL
Rice	Basal	Taizhou	http://www.jsnk.com.cn/2026/0612/c420a262617/page.htm https://www.ourjiangsu.com/a/20200619/1592554695628.shtml http://www.ourjiangsu.com/a/20230627/1687859436548.shtml http://wap.jingjiang.gov.cn/tpxw/art/2026/art_1229823442.html https://www.mytaizhou.net/folder114/folder54/folder924/2025-06-20/780897.html
Rice	Basal	Yancheng	http://vip.people.com.cn/albumsDetail?aid=1813332&pid=13289284 https://www.ourjiangsu.com/a/20230614/1686730148506.shtml https://js.cnr.cn/qxlb/20260625/t20260625_527676399.shtml
Rice	Basal	Xuzhou	https://www.cnxz.com.cn/newsDetail?DetailId=193910772366017740 8 https://news.sina.com.cn/zx/gj/2025-02-26/doc-inemvhax3488054.shtml
Rice	Basal	Nantong	http://vip.people.com.cn/albumsDetail?aid=1816207
Rice	Basal	Suzhou	http://www.skiad.com.cn/2026/0605/c117a1815/page.htm
Rice	Basal	Suqian	http://vip.people.com.cn/albumsDetail?aid=1563421
Rice	Basal	Hefei	https://news.cnr.cn/native/gd/20260627/t20260627_527679189.shtml https://www.toutiao.com/article/7647017904281518638/ https://www.hf365.com/hfzx/system/2026/07/03/030082801.shtml https://news.qq.com/rain/a/20260605A07EMK00 https://finance.sina.com.cn/jjxw/2026-06-17/doc-inicsmhx7171805.shtml https://www.hf365.com/hfzx/system/2026/05/19/030064107.shtml
Rice	Basal	Ma'anshan	http://ah.anhuinews.com/mas/tp/202406/t20240620_7635615.html http://vip.people.com.cn/albumsDetail?aid=1952822&pid=14500446 http://vip.people.com.cn/albumsDetail?aid=1809609&pid=13257934 http://vip.people.com.cn/albumsDetail?aid=1950555&pid=14480116 http://vip.people.com.cn/albumsDetail?aid=1682044
Rice	Basal	Chuzhou	http://szbk.chuzhou.cn/czrb/pc/content/202606/18/content_150502.html

Crop	Application Method	prefecture-level city	URL
Rice	Basal	Anqing	https://m.ahwang.cn/ios/p/2708278.html https://chuzhou.ahwang.cn/cznews/20250613/2871113.html http://vip.people.com.cn/albumsDetail?aid=1949810 http://vip.people.com.cn/albumsDetail?aid=1949047 http://vip.people.com.cn/albumsDetail?aid=1803513&pid=13205822 http://vip.people.com.cn/albumsDetail?aid=1686218&pid=12211956 https://m.ahwang.cn/ios/p/2673969.html
Rice	Basal	Bengbu	https://www.ctdsb.net/c1741_202306/1802300.html https://www.163.com/dy/article/I7K0O6IC05346936.html https://www.ahhy.gov.cn/xwzx/bmdt/81354844.html
Rice	Basal	Wuhu	http://vip.people.com.cn/albumsDetail?aid=1925014 http://vip.people.com.cn/albumsDetail?aid=1953377&pid=14505255
Rice	Basal	Huainan	http://vip.people.com.cn/albumsDetail?aid=1953034 https://www.huainan.gov.cn/zwgk/xqdt/1259695574.html
Rice	Basal	Lu'an	https://www.luan.gov.cn/zwzx/tpxw/10771216.html#ad-image-0 https://www.toutiao.com/article/7517137143425270326/
Rice	Basal	Huangshan	http://ah.anhuinews.com/hs/hsxqdt/qm/202404/t20240423_7524339.html http://www.ah.xinhuanet.com/20240423/53c31d3f6b8f4850ad07e29ca355904d/c.html
Rice	Basal	Nanchang	https://www.nc.gov.cn/ncszf/jrnc/202606/fa4c5b95fbdb46db98bdc3c62b4d1f0b.shtml https://www.sohu.com/a/787260041_121117078 https://www.gov.cn/yaowen/2023-04/13/content_5751278.htm#1 https://www.nc.gov.cn/ncszf/xqdt/202604/8253a922198f4f57b9c2efa5a7f4135b.shtml https://www.nc.gov.cn/ncszf/jrnc/202504/91e5e6ceb4584f93b30b338f9a98c9fb.shtml
Rice	Basal	Jiujiang	https://www.xiushui.gov.cn/zwzx_314/zwyw/202604/t20260423_7227243.html

Crop	Application Method	prefecture-level city	URL
Rice	Basal	Ji'an	https://jx.cnr.cn/tp/20260419/t20260419_527590995.shtml https://www.sohu.com/a/909776994_121443915 https://www.jjxw.cn/article/2025/06/20/709566.html http://vip.people.com.cn/albumsDetail?aid=1798832&pid=13166416 http://vip.people.com.cn/albumsDetail?aid=1953646 http://vip.people.com.cn/albumsDetail?aid=1816140&pid=13312942 http://vip.people.com.cn/albumsDetail?aid=1538881&pid=11000779 https://jx.ifeng.com/c/8YtwFG1YCYS https://m.gmw.cn/2026-04/14/content_1304416885.htm http://www.jx.xinhuanet.com/20260705/de6b444d70b243e59363d58ba893f867/c.html http://jx.people.com.cn/n2/2026/0521/c186330-41587383.html https://www.jxlcx.gov.cn/art/2026/4/18/art_2434_4441466.html
Rice	Basal	Fuzhou	http://vip.people.com.cn/albumsDetail?aid=1826148&pid=13399099 https://jx.people.com.cn/n2/2026/0421/c186330-41559011.html http://vip.people.com.cn/albumsDetail?aid=1923093&pid=14239038 http://vip.people.com.cn/albumsDetail?aid=1537619&pid=10990903
Rice	Basal	Shangrao	https://www.sohu.com/a/890143290_121106994 https://jx.ifeng.com/c/8sTQ25uPcEl http://vip.people.com.cn/albumsDetail?aid=1931632 http://vip.people.com.cn/albumsDetail?aid=1791055&pid=13099524
Rice	Basal	Ganzhou	https://news.sina.com.cn/zx/gj/2025-04-03/doc-inerwfmt2707789.shtml http://vip.people.com.cn/albumsDetail?aid=1918419
Rice	Basal	Pingxiang	https://jiangxi.jxnews.com.cn/system/2026/04/28/031116031.shtml https://jj.jxnews.com.cn/system/2024/06/28/020550750.shtml
Rice	Basal	Jingdezhen	https://jx.ifeng.com/c/8iXRx5w4tp3
Rice	Basal	Yichun	http://vip.people.com.cn/albumsDetail?aid=1536975&pid=10985808
Rice	Basal	Changde	https://agri.hunan.gov.cn/agri/xxgk/gzdt/sxdt_1/202404/t20240410_33273530.html

Crop	Application Method	prefecture-level city	URL
			http://cdrb.cdyee.com/pad/content/202604/26/content_252250.html
			https://www.hunan.gov.cn/hnszf/hnyw/szdt/202407/t20240727_33365531.html
			https://www.hunantoday.cn/news/xhn/202104/16411829.html
			https://cd.voc.com.cn/news/202604/32424055.html
			https://cd.voc.com.cn/news/202604/32424055.html
			https://www.yizhangxww.cn/content/646048/66/15860558.html
Rice	Basal	Chenzhou	https://agri.hunan.gov.cn/agri/xxgk/gzdt/sxdt_1/202504/t20250424_33653312.html
			https://hn.rednet.cn/content/646041/59/16084625.html
			https://cz.rednet.cn/content/646941/52/15137270.html
			https://xczx.fjsen.com/2026-04/30/content_32172581.htm
			https://news.sina.cn/2018-04-27/detail-ifztkpin9480536.d.html
Rice	Basal	Yiyang	https://m.voc.com.cn/xhn/news/202604/32402100.html
			https://www.yiyang.gov.cn/yiyang/36457/36467/36513/content_1928460.html
			https://www.guzhangxinwen.com.cn/content/13730000
Rice	Basal	Xiangxi	http://vip.people.com.cn/albumsDetail?aid=1686081
			http://vip.people.com.cn/albumsDetail?aid=1806855&pid=13234150
			https://www.toutiao.com/article/7493333891684794916/
Rice	Basal	Yongzhou	http://vip.people.com.cn/albumsDetail?aid=1696422&pid=12297007
			http://vip.people.com.cn/albumsDetail?aid=1923174&pid=14239677
			https://www.hunantoday.cn/news/xhn/202504/28275617.html
Rice	Basal	Hengyang	http://www.hn.xinhuanet.com/20260521/b83a091bcf294791a9979073cdf06769/c.html
			https://hy.rednet.cn/content/646048/51/15850300.html
			https://news.qq.com/rain/a/20250418A06TQA00
Rice	Basal	Shaoyang	https://www.cnr.cn/hunan/zhxw/20240420/t20240420_526673921.shtml
			https://hn.rednet.cn/content/646948/67/14896991.html

Crop	Application Method	prefecture-level city	URL
Rice	Basal	Zhuzhou	http://vip.people.com.cn/albumsDetail?aid=1783386 https://www.news.cn/photo/20240406/9ee7cb45014b42468ca90a2d8329539b/c.html https://www.hunan.gov.cn/topic/kjbh/xcxqqy/gzjxs05/szdt05/202604/t20260421_33960565.html
Rice	Basal	Changsha	https://www.ctdsb.net/c1741_202304/1723271.html https://news.changsha.cn/xctt/html/110187/20250414/198211.html
Rice	Basal	Loudi	http://vip.people.com.cn/albumsDetail?aid=1790861 https://agri.hunan.gov.cn/agri/xxgk/gzdt/sxdt_1/202404/t20240410_33273558.html
Rice	Basal	Huaihua	https://www.huaihua.gov.cn/huaihua/c101116/202606/1df5a8ec72bf4766b9839094836ef9ac.shtml
Rice	Basal	Yueyang	https://www.toutiao.com/article/7640480187829846528/ https://www.huarong.gov.cn/33047/content_2373827.html
Rice	Basal	Xiangtan	https://www.hunan.gov.cn/hnszf/hnyw/szdt/202504/t20250418_33645741.html
Wheat	Basal	Shijiazhuang	https://www.btwmw.net/content/content_2014203.html https://www.hebei.gov.cn/columns/580d0301-2e0b-4152-9dd1-7d7f4e0f4980/202410/23/79ca9c2a-2f9e-4016-b3bd-8749e6edd833.html
Wheat	Basal	Baoding	https://m.thepaper.cn/newsDetail_forward_29134876 https://www.xinhuanet.com/food/20251104/3c4caf9c86c44620bbfc996ff15e1711/c.html http://tuopin.ce.cn/news/202511/t20251112_2575392.shtml https://heb.hebccw.cn/system/2025/10/28/102117100.shtml https://mp.weixin.qq.com/s?__biz=MzI1ODQ0MDg5Mg==&mid=2247521778&idx=6&sn=66b3ee17176d7621e4d8fa0774904d1e&chksm=eb22fe8b322cd6fd3b029346c8cd6a4d840f56c08ad27203cc4f49e74ae4dbecf31bb13c7101&scene=27
Wheat	Basal	Cangzhou	https://www.heb.chinanews.com.cn/shfz/20221104428769.shtml

Crop	Application Method	prefecture-level city	URL
Wheat	Basal	Hengshui	http://www.he.xinhuanet.com/20241024/5152f8aa092042a4a57f50efe233d9fb/c.html https://www.heb.chinanews.com.cn/shfz/20221021428347.shtml http://www.hsagri.cn/Article/Show/28706 https://www.163.com/dy/article/JENJTPDA0512BM80.html https://www.qhdnews.com/content/202510/25/c59714.html http://he.cma.gov.cn/xwdt/ttxw/202311/t20231102_5866151.html https://baijiahao.baidu.com/s?id=1715931513712716898&wfr=spider&for=pc https://k.sina.cn/article_3740356007_def14da702002jhqe.html https://k.sina.cn/article_3740356007_def14da702002jhqe.html https://hebei.ifeng.com/c/8KQfN7AGYG7
Wheat	Basal	Xingtai	https://www.hebtv.com/19/19js/zx/tt/10946941.shtml http://vip.people.com.cn/albumsDetail?aid=1485334 https://news.cctv.com/2025/11/02/ARTIg0oSuu93I3xHhK1DGNlT251102.shtml https://heb.hebccw.cn/system/2025/10/28/102117100.shtml https://heb.hebccw.cn/system/2024/10/23/101395131.shtml https://www.sohu.com/a/947494377_121106842 https://www.toutiao.com/article/7569036440860901930/ http://vip.people.com.cn/albumsDetail?aid=1999240&pid=14910844
Wheat	Basal	Handan	http://www.jinanxinqu.gov.cn/zjxq/xzdt/202510/t20251031_2164781.html https://www.cma.gov.cn/ztbd/2024zt/2024qxr/2024031509/202403/t20240321_6142878.html https://finance.sina.com.cn/money/bond/2025-10-24/doc-infuyzvk6786304.shtml https://www.toutiao.com/article/7568685703513555491/
Wheat	Basal	Fuyang	https://zhuanlan.zhihu.com/p/4213746233 https://www.163.com/dy/article/JF3UOAQA0516W9RA.html

Crop	Application Method	prefecture-level city	URL
Wheat	Basal	Suzhou	https://news.cctv.com/2025/11/03/ARTIYGqpqjnVtbaHIc7bfZWx251103.shtml https://news.qq.com/rain/a/20231027A06VLZ00 http://ah.anhuinews.com/szxw/202411/t20241103_7971692.html http://ah.anhuinews.com/fy/mlfy/202310/t20231026_7186914.html https://www.ahcaijing.com/html/2024/suzhou_1023/507939.html https://www.163.com/dy/article/IID1H87L05502PRR.html https://m.sohu.com/a/951979919_121106991/ http://vip.people.com.cn/albumsDetail?aid=1484872 http://vip.people.com.cn/albumsDetail?aid=1861493 https://ah.people.com.cn/n2/2025/1029/c375162-41394261.html
Wheat	Basal	Bozhou	https://www.ahbztv.com/w/2310/WZ0e8d3da8b3fa84051ae4ea1d79ea4287c.html https://www.bozhou.gov.cn/News/show/619969.html http://ah.anhuinews.com/bozhou/news/yw/202510/t20251028_8874210.html
Wheat	Basal	Chuzhou	http://szbk.chuzhou.cn/czrb/pc/content/202411/12/content_122620.html https://www.chuzhou.gov.cn/zxzx/tpxw/1112725272.html https://www.chuzhou.gov.cn/ztzl/xczxzlzxd/xzgj/1110315137.html http://www.anhuinews.com/ahkj/jhkj/202211/t20221101_6484090.html
Wheat	Basal	Bengbu	https://bb.ahwang.cn/bbnews/20241022/2761629.html https://news.cri.cn/n/20241025/bebbf705-f5da-e07d-533d-da8d8e3ef1c8.html https://bb.ahwang.cn/bbnews/20251031/2927642.html https://www.163.com/dy/article/HL14B4TI0530QRMB.html https://baijiahao.baidu.com/s?id=1680677458466426586&wfr=spider&for=pc
Wheat	Basal	Huainan	https://www.maoji.gov.cn/zxzx/bmdt/8173886.html

Crop	Application Method	prefecture-level city	URL
Wheat	Basal	Xuzhou	https://news.jstv.com/a/20221016/1665909842271.shtml https://www.moa.gov.cn/xw/qg/202210/t20221028_6414330.htm https://jsnews.jschina.com.cn/xz/a/202311/t20231107_3313938.shtml https://baijiahao.baidu.com/s?id=1715646311782128461&wfr=spider&for=pc http://vip.people.com.cn/albumsDetail?aid=1856282
Wheat	Basal	Yancheng	https://www.zgjssw.gov.cn/yaowen/202511/t20251110_8536964.shtml https://www.cicphoto.com/cn/view14417828 https://m.thepaper.cn/baijiahao_29164013 http://www.js.xinhuanet.com/20241104/a5ae114a42ff4de794946b3ca07ce778/c.html https://www.ourjiangsu.com/a/20231108/1699435995900.shtml
Wheat	Basal	Huai'an	https://www.msn.com/zh-cn/news/other/%E6%B1%9F%E8%8B%8F%E6%B7%AE%E5%AE%89-%E5%86%AC%E5%B0%8F%E9%BA%A6%E6%92%AD%E7%A7%8D%E5%BF%99/ss-AA1PLwJg https://baijiahao.baidu.com/s?id=1715223842247913000&wfr=spider&for=pc http://www.js.xinhuanet.com/20251106/7b2e38db1eb04e44b293de2979c4c74b/c.html
Wheat	Basal	Lianyungang	https://www.toutiao.com/article/7295268090479690267/ https://www.yzwb.net/news/jiangsu/202510/t20251023_280396.html http://vip.people.com.cn/albumsDetail?aid=1998689 https://www.ourjiangsu.com/wap/a/part/20221102/166737560275.shtml
Wheat	Basal	Suqian	https://www.ourjiangsu.com/a/20221026/1666790579258.shtml https://www.suxinwen.cn/news/2292515 https://wap.yzwb.net/wap/news/1736356.html http://vip.people.com.cn/albumsDetail?aid=1599030

Crop	Application Method	prefecture-level city	URL
Wheat	Basal	Taizhou	https://jsnews.jschina.com.cn/jsyw/202510/t20251031_s69040467e4b0dec50a1de5a7.shtml https://www.mytaizhou.net/folder114/folder44/folder51/2025-11-12/802865.html http://www.taixing.cn/html/news/jujiaotaixing/2024/1203/142385.html
Wheat	Basal	Nantong	https://www.zgjssw.gov.cn/shixianchuanzhen/nantong/202511/t20251103_8534998.shtml
Wheat	Basal	Suzhou	https://www.suzhou.gov.cn/szsrmzf/xdny/202411/284b47f7fbc84549ad0ef57f4db188e6.shtml
Wheat	Basal	Zhenjiang	https://zgjssw.jschina.com.cn/shixianchuanzhen/zhenjiang/202311/t20231114_8148027.shtml
Wheat	Basal	Nanjing	https://www.nanjing.gov.cn/zzb/ywdt/njxx/202311/t20231117_4100043.html
Wheat	Basal	Heze	http://www.heze.cn/Exposure%20stage/2025-11/05/content_646854.html http://www.heze.cn/County%20News/2025-10/28/content_646164.html https://www.163.com/dy/article/IHH1BPI10514CFC7.html https://heze.iqilu.com/hzyaowen/2023/1031/5539034.shtml https://news.cctv.com/2025/10/24/ARTITZziXtRUBu8OoAoF1w9D251023.shtml https://www.sohu.com/a/951034787_120099050 https://news.sina.com.cn/zx/gj/2025-11-30/doc-infzeqta5115577.shtml
Wheat	Basal	Dezhou	https://dezhou.dzwww.com/news/202210/t20221027_10987009.html https://m.dezhoudaily.com/yaowen/p/1670278.html https://www.toutiao.com/article/7568679061178843683/
Wheat	Basal	Liaocheng	https://www.sd.news.cn/20251104/8e680d8a36354cc28fe1f360b904cb9f/c.html http://vip.people.com.cn/albumsDetail?aid=2003439

Crop	Application Method	prefecture-level city	URL
Wheat	Basal	Jining	https://www.163.com/dy/article/KCL5AIVC0514CFC7.html https://m.gmw.cn/2024-10/26/content_1303881309.htm https://news.haiwainet.cn/n/2025/1030/c3541092-32904727.html https://www.news.cn/politics/20260612/7440d85973154dec97959d65da14bab6/c.html https://www.sohu.com/a/949688236_121300363 https://finance.sina.com.cn/jjxw/2024-10-29/doc-incueanm9127834.shtml https://news.cctv.cn/2025/11/25/ARTIUlRay6XTHle4TLdy4Um42511 25.shtml https://www.toutiao.com/article/7567299913801925154/
Wheat	Basal	Weifang	http://h5.wfwb.wfnews.com.cn/content/20251104/Articel03004MN.htm https://www.toutiao.com/article/7159788828096463364/
Wheat	Basal	Linyi	https://news.qq.com/rain/a/20251024A04HID00 https://iapp.sgrmt.com/share/YS0yNzktNDEzMTkzMTM.html https://baijiahao.baidu.com/s?id=1847821945249984496&wfr=spider&for=pc https://www.linyi.gov.cn/info/1333/405986.htm https://news.sohu.com/a/948807198_121117082 https://baijiahao.baidu.com/s?id=1747769204828690579&wfr=spider&for=pc
Wheat	Basal	Binzhou	https://news.bjd.com.cn/2025/11/03/11385559.shtml https://binzhou.iqilu.com/bzminsheng/2022/1022/5263901.shtml https://baijiahao.baidu.com/s?id=1715413351051295764&wfr=spider&for=pc
Wheat	Basal	Qingdao	https://w.dzwww.com/p/9324510.html https://www.agri.cn/zx/xxlb/sd/202511/t20251106_8783497.htm https://lanmu.qtv.com.cn/system/2025/11/10/016134644.shtml

Crop	Application Method	prefecture-level city	URL
Wheat	Basal	Jinan	http://www.qingdao.gov.cn/zwgk/xxgk/nync/gkml/gzxx/202110/t20211025_3663858.shtml http://sd.people.com.cn/n2/2023/1030/c356084-40621884.html https://news.e23.cn/shandong/2025-11-07/2025B0700032.html https://baijiahao.baidu.com/s?id=1848392418525357396&wfr=spider&for=pc https://baijiahao.baidu.com/s?id=1714315895815534467&wfr=spider&for=pc https://sdxw.iqilu.com/share/YS0yMS04NDY4Mjc5.html
Wheat	Basal	Tai'an	https://news.sina.com.cn/zx/gj/2025-11-30/doc-infzeqta5115577.shtml
Wheat	Basal	Yantai	https://m.163.com/dy/article/KD70U7880514CFC7.html
Wheat	Basal	Zibo	http://h5.wfwb.wfnews.com.cn/content/20251104/Articel02001MN.htm
Wheat	Basal	Dongying	https://c.cicphoto.com/cn/view14419131 https://zhidao.baidu.com/question/1524926768785439300.html https://baijiahao.baidu.com/s?id=1813583449269736862&wfr=spider&for=pc http://m.people.cn/n4/2020/1022/c1179-14506038.html
Wheat	Basal	Zhoukou	https://www.zhoukou.gov.cn/page_pc/xwzx/zkyw/article7b9dbfd539374efdb674e51ba5010fa1.html https://www.toutiao.com/article/7429583416233886227/ http://www.zhoukouwenming.cn/sitesources/zkwmw/page_pc/xwzx/tpxw/article5bb0c1557783442288246aca71ba449.html https://hn.cnr.cn/hnpdgb/hngexb/20221021/t20221021_526039310.html http://henan.china.com.cn/m/2023-10/26/content_42567852.html
Wheat	Basal	Zhumadian	https://baijiahao.baidu.com/s?id=1781403667861559886&wfr=spider&for=pc https://hn.cnr.cn/hnpdgb/hngexb/20221031/t20221031_526046737.html

Crop	Application Method	prefecture-level city	URL
			http://henan.china.com.cn/news/2023-10/23/content_42562932.htm http://news.hnr.cn/snxw/article/1/1851903447413907457 https://www.zmdtvw.cn/sannong/show-16-337418-0.html http://www.zmdnews.cn/2024/1023/806357.shtml https://www.zmdtvw.cn/showinfo-16-337332-0.html http://zmdrb.zmdnews.cn/zmdrb/20251107/mhtml/index_content_20251107001006.htm https://mp.weixin.qq.com/s?__biz=MzkwNjI2NjY4MA==&mid=2247533166&idx=6&sn=80b9667e88849312bbb805943e540b7e&chksm=c1cb0d955d9d79e9c33f83d5c1994d6c90a6789576e5869635b554e692833c77af42f1bc0f8a&scene=27 https://hn.cnr.cn/hnpdgb/jdt/20231027/t20231027_526465605.html
Wheat	Basal	Nanyang	https://mp.weixin.qq.com/s?__biz=MzIwNTc0MzM0OA==&mid=2247638581&idx=5&sn=561009a3d3e22b7c70345df086427a5e&chksm=96ca62e6e4cdadcb125c24f0565af1cf60aa5cce7f9bd740459754c9aa600fdd5a3bf0ffd142&scene=27 https://www.hnzx.gov.cn/2025/11-10/4358277.html https://www.toutiao.com/article/7432167508000145935/ https://baijiahao.baidu.com/s?id=1847947106506735859&wfr=spider&for=pc https://www.henan.gov.cn/2022/10-19/2626104.html https://www.henan.gov.cn/2023/10-25/2835490.html
Wheat	Basal	Shangqiu	https://rb-sly.loulannews.com/html/2025-11/04/content_263_272580.htm https://www.henan.gov.cn/2023/10-20/2832814.html http://sq.hnr.cn/dsshangqiu/article/1/1850844245252333569 https://sq.henance.com/show-60852.html https://www.henan.gov.cn/2024/10-19/3075696.html
Wheat	Basal	Xinxiang	https://www.henan.gov.cn/2024/10-23/3077192.html https://www.henan.gov.cn/2021/11-01/2339272.html

Crop	Application Method	prefecture-level city	URL
Wheat	Basal	Xinyang	https://www.hntv.tv/rhh-6398872578/article/1/1716000601238368257 https://www.163.com/dy/article/KCGHA95P0550B6IS.html https://baijiahao.baidu.com/s?id=1847942715749012979&wfr=spider&for=pc https://hn.cnr.cn/hnpdgb/yw/20241104/t20241104_526964451.html https://news.sohu.com/a/595589124_120347736 https://hn.cnr.cn/hnpdgb/hngexb/20221020/t20221020_526039006.html https://baijiahao.baidu.com/s?id=1748076894103915717&wfr=spider&for=pc http://xy.hnr.cn/xyjpyc/article/1/1584741411804868610 https://www.kf.cn/c/2023-11-04/858960.shtml https://www.hntv.tv/news/0/1713900421205925889
Wheat	Basal	Kaifeng	https://www.farmer.com.cn/2022/10/19/wap_99901261.html https://www.henan.gov.cn/2018/11-01/713705.html https://www.hncoop.com/zhxx/2025-11-03/176213209941691.html https://www.henan.gov.cn/2025/11-05/3242446.html https://baijiahao.baidu.com/s?id=1814047215861885663&wfr=spider&for=pc https://www.henan.gov.cn/2024/11-04/3081673.html
Wheat	Basal	Anyang	https://www.hnhx.gov.cn/portal/xwzx/xzdt/webinfo/2024/10/1730445592461545.htm https://www.jingjiribao.cn/static/detail.jsp?id=487439 https://www.hnhx.gov.cn/portal/xwzx/bmdt/webinfo/2025/11/phone1762164202283846.htm
Wheat	Basal	Luoyang	https://mp.weixin.qq.com/s?__biz=MzIyNjIzNTQxNQ==&mid=2649846040&idx=1&sn=a5f89f0397a933dfaab92ec23e64c26c&chksm=f0765460c701dd76a5d161e70c9332241626c8d62693615e95c085ccaf258c4b7a681e027632&scene=27

Crop	Application Method	prefecture-level city	URL
Wheat	Basal	Xuchang	https://baijiahao.baidu.com/s?id=1681671040981604368&wfr=spider&for=pc https://xianqu.lyd.com.cn/system/2024/10/21/032469523.shtml https://mp.weixin.qq.com/s?__biz=MjM5OTc3NzI4Mg==&mid=2652283791&idx=3&sn=93f1a2782de14ba104f8c35a805b3f7c&chksm=bcd446e28ba3cff4f1b9fee5851fe3bd79e0d99dd4989691520c4a29105b7b28be4b52f8dc3e&scene=27 https://mp.weixin.qq.com/s?__biz=MzIyNzU3MDIwOA==&mid=2247522552&idx=2&sn=293e73bdd70fb6808dd70934b462f4be&chksm=e97c903ed5346dbbc34752b07efea576a0258a5f477eb440ee5ea7e8b2689159ceaa34065b63&scene=27 https://www.henan.gov.cn/2022/10-26/2629018.html https://www.henan.gov.cn/2024/10-16/3073927.html https://www.hntv.tv/xuchang/article/1/1849009824224206849
Wheat	Basal	Pingdingshan	https://www.henan.gov.cn/2020/10-27/1837435.html https://news.qq.com/rain/a/20251104A06BC100 https://www.news.cn/photo/20260504/0cd2267b5ece41f6a3d7b03d702ac767/c.html https://baijiahao.baidu.com/s?id=1864672786927965592&wfr=spider&for=pc
Maize	Basal	Heihe	https://www.news.cn/20260430/64c4e50855404bf7a99b2190d47985a3/c.html https://www.news.cn/20260430/64c4e50855404bf7a99b2190d47985a3/c.html https://baijiahao.baidu.com/s?id=1863875066747368491&wfr=spider&for=pc https://picture.youth.cn/qtdb/202605/t20260504_16642003_5.htm https://picture.youth.cn/qtdb/202605/t20260504_16642003_5.htm
Maize	Basal	Jiamusi	https://hlj.cnr.cn/dsdt/20260417/t20260417_527588857.shtml https://www.hljnews.cn/jjny/content/2026-05/20/content_892882.html

Crop	Application Method	prefecture-level city	URL
Maize	Basal	Jixi	https://www.hlj.gov.cn/hlj/c108541/202605/c00_31937542.shtml https://www.hlj.gov.cn/hlj/c108541/202605/c00_31937542.shtml https://m.chinabdh.com/h-nd-7644.html
Maize	Basal	Shuangyashan	https://www.163.com/dy/article/JUSP6PUH05538QLM.html https://nynct.hlj.gov.cn/nynct/c115380/202505/c00_31837839.shtml
Maize	Basal	Qiqihar	https://www.hlj.chinanews.com.cn/hljnews/2026/0519/158707.html https://picture.youth.cn/qtdb/202605/t20260504_16642003_5.htm
Maize	Basal	Daqing	https://www.zhaozhou.gov.cn/zhaozhou/xxfb11/202405/c05_339516.shtml https://www.eco.gov.cn/news_info/33861.html
Maize	Basal	Hegang	https://www.hlj.gov.cn/hlj/c107856/202312/c00_31695568.shtml
Maize	Basal	Mudanjiang	http://www.moa.gov.cn/xw/qg/202405/t20240531_6456430.htm
Maize	Basal	Harbin	http://www.hrbsc.gov.cn/hebscq/c110683/202604/c01_1122975.shtml
Maize	Basal	Changchun	http://www.changchun.gov.cn/ztlm/jzjstpgj/gztjjcx/202605/t20260506_3485050.html http://jlrbszb.dajilin.com/pc/paper/c/202605/03/content_1050014.html
Maize	Basal	Siping	http://www.jl.gov.cn/yaowen/202604/t20260407_3621466.html http://jl.people.com.cn/n2/2026/0501/c349771-41569531.htm http://www.jl.gov.cn/yaowen/202605/t20260512_3630028.html http://jlrbszb.dajilin.com/pad/paper/c/202605/12/content_1050625.html https://www.jl.gov.cn/yaowen/202605/t20260512_3630028.html http://nw.siping.gov.cn/gzdt/202305/t20230512_664532.html
Maize	Basal	Songyuan	http://nw.siping.gov.cn/gzdt/202305/t20230512_664532.html https://www.jl.gov.cn/szfzt/jlyhyshjjxs/dxzf/202605/t20260519_3631524.html
Maize	Basal	Baishan	https://www.ndrc.gov.cn/fggz/nyncjj/zdjs/202306/t20230607_1357332.html
Maize	Basal	Liaoyuan	http://www.liaoyuan.gov.cn/xxgk/dtxw/zwlb/xqdt/202605/t20260511_736510.html

Crop	Application Method	prefecture-level city	URL
Maize	Basal	Yingkou	https://www.yingkou.gov.cn/001/001007/001007034/001007034001/20250512/c88d9092-eb1c-42ee-bbec-d06de09b32cc.html https://www.yingkou.gov.cn/001/001007/001007034/001007034001/20250512/c88d9092-eb1c-42ee-bbec-d06de09b32cc.html https://www.yingkou.gov.cn/001/001009/20240510/871766d2-f439-4583-92a2-ca0d88993f93.html
Maize	Basal	Tieling	http://demo.sinoverse.cn/news/show/?id=7f5574c57fa54411a7fced9771dcb51e https://www.ln.gov.cn/web/ywdt/jrln/wzxx2018/20260509092122350 86/
Maize	Basal	Dalian	https://finance.sina.cn/2026-05-22/detail-inhytyyr7730437.d.html?vt=4&cid=76729&node_id=76729
Maize	Basal	Chaoyang	https://chaoyang.gov.cn/html/CYSZF/202405/0171532993053433.html
Maize	Basal	Panjin	https://www.panjin.gov.cn/html/1738/2026-04-22/content-150830.html
Maize	Basal	Handan	https://heb.chinadaily.com.cn/a/202606/16/WS6a30b505a310d709c2fb8437.html
Maize	Basal	Hengshui	https://heb.hebccw.cn/system/2026/06/20/102196213.shtml https://heb.hebccw.cn/system/2026/06/20/102196213.shtml https://www.thepaper.cn/newsDetail_forward_27768263
Maize	Basal	Shijiazhuang	https://nyncj.sjz.gov.cn/columns/308bd406-5e94-435b-98d9-476cb2aa5ec3/202606/17/a12a8288-92de-483a-8e41-3347c1d908a5.html
Maize	Basal	Xingtai	https://finance.sina.cn/2026-06-14/detail-inicipvz0909932.d.html
Maize	Basal	Zhangjiakou	https://digi.china.com/articles/20260513/202605131868021.html
Maize	Basal	Tangshan	https://nyncj.tangshan.gov.cn/nongmuju/xqxx/20240716/1610466.html
Maize	Basal	Chengde	https://www.qhdnews.com/content/202605/12/c67975.html
Maize	Basal	Baoding	https://heb.hebccw.cn/system/2026/06/20/102196213.shtml

Crop	Application Method	prefecture-level city	URL
Maize	Basal	Tongliao	http://nm.people.com.cn/n2/2026/0508/c196820-41573984.html https://epaper.tongliaowang.com/paper/wap/content/202605/14/content_43033.html
Maize	Basal	Chifeng	https://nmj.chifeng.gov.cn/zwxx/sndt/qxdt/202405/t20240514_2317456.html https://www.ybs.gov.cn/bsdt/bsxw/202605/t20260507_2762235.html
Maize	Basal	Hulunbuir	http://nm.people.com.cn/n2/2026/0509/c192247-41575055.html https://finance.sina.com.cn/jjxw/2026-04-30/doc-inhwhkue6265981.shtml?froms=ggmp
Maize	Basal	Hinggan League	https://szb.northnews.cn/nmgrb/html/2026-04/27/content_56432_279158.htm https://news.gmw.cn/2023-04/20/content_36507893.htm
Maize	Basal	Baotou	http://m.waihui888.com/xwpd/xwpd/2026/0430/75743.html
Maize	Basal	Bayannur	https://nm.cnr.cn/gstjnmg/20230430/t20230430_526237224.shtml https://www.cnr.cn/sd/gstjsd/20260701/t20260701_527684720.shtml
Maize	Basal	Liaocheng	http://sd.news.cn/20260610/0e349aea3fbf40799ef079b140334983/c.html
Maize	Basal	Jinan	http://www.sd.news.cn/20260610/4d1d34c0efec4fa2b013b323fea6493e/c.html
Maize	Basal	Qingdao	https://news.qq.com/rain/a/20250620A07V7200
Maize	Basal	Dezhou	https://news.iqilu.com/shandong/shandonggedi/20260605/5919795.shtml
Maize	Basal	Heze	https://sd.dzwww.com/sdnews/202606/t20260610_17823450.htm
Maize	Basal	Binzhou	https://news.qq.com/rain/a/20260623A02XNU00
Maize	Basal	Jining	http://agri.china.com.cn/2026-06/18/content_43449713.htm
Maize	Basal	Rizhao	https://www.rznews.cn/viscms/rizhaoxinwen0271/20260626/761461.html
Maize	Basal	Nanyang	https://www.cnr.cn/hnfw/hnpdgb/hngexb/20260604/t20260604_527648217.html

Crop	Application Method	prefecture-level city	URL
Maize	Basal	Zhoukou	https://www.cnr.cn/hnfw/hnpdgb/hngexb/20260604/t20260604_527648217.html https://www.hnzx.gov.cn/2025/05-26/4352033.html http://ha.news.cn/20260606/6759c71eaa144cb6b8bdd537fae78226/c.html https://www.shenqiu.gov.cn/newslast_39181.html http://m.zmdnews.cn/article/505553
Maize	Basal	Shangqiu	http://m.zmdnews.cn/article/505553 https://www.sqrb.com.cn/content/2026-06/15/content_289247.html https://www.sqrb.com.cn/content/2026-06/15/content_289247.html
Maize	Basal	Anyang	http://www.jingjiribao.cn/static/detail.jsp?id=662341 http://ha.news.cn/20260606/6759c71eaa144cb6b8bdd537fae78226/c.html
Maize	Basal	Hebi	http://ha.people.com.cn/n2/2026/0611/c378397-41607451.html https://www.henan100.com/news/2023/1155698.shtml
Maize	Basal	Kaifeng	http://ha.news.cn/20260606/6759c71eaa144cb6b8bdd537fae78226/c.html
Maize	Basal	Luohe	https://www.lhrb.com.cn/2026/07/03/99598623.html
Maize	Basal	Xuchang	https://www.henan100.com/news/2023/1155903.shtml
Maize	Basal	Xinxiang	https://www.hnjjbs.com/article/2026-06/178045531458561.html
Maize	Basal	Sanmenxia	https://www.ismx.cn/content-10-118479-1.html
Rice	Topdressing	Yancheng	https://mp.weixin.qq.com/s?__biz=MzA4MTYzMjc1MQ==&mid=2649997052&idx=8&sn=7bcef4f94fb5aa3ec09e4c9931fb353f&chksm=86d37d16d770cebafec59b59cba0dd88880297f408cb362f97f9022731385fe2614c917e6e47&scene=27
Rice	Topdressing	Huai'an	http://www.amic.agri.cn/secondLevelPage/info/37/162505
Rice	Topdressing	Jiamusi	https://www.agri.cn/zx/xxlb/hlj/202606/t20260617_8844897.htm
Rice	Topdressing	Harbin	https://hea.china.com/articles/20260625/202606251902094.html
Rice	Topdressing	Shuangyashan	https://www.agri.cn/zx/xxlb/hlj/202606/t20260617_8844901.htm
Rice	Topdressing	Hefei	https://news.ahwang.cn/zhengwu/20230731/2547679.html

Crop	Application Method	prefecture-level city	URL
Rice	Topdressing	Yichun	https://www.yichun.gov.cn/ycsrmzf/bmxx/202405/ef98318ed45045eaaed1901cdc8cdf75.shtml
Rice	Topdressing	Hengyang	https://m.voc.com.cn/rmt/article/13973165.html
Wheat	Topdressing	Heze	https://baijiahao.baidu.com/s?id=1762419366462120840&wfr=spider&for=pc
Wheat	Topdressing	Dezhou	https://www.sd.news.cn/20260414/9ab6178794454a9ea88bc276955d3354/c.html https://sdxw.iqilu.com/share/YS0yMS0xNjM5ODM4NQ==.html https://sdxw.iqilu.com/share/YS0yMS0xNjM5NDk1Ng.html
Wheat	Topdressing	Liaocheng	https://baijiahao.baidu.com/s?id=1729363361726642197&wfr=spider&for=pc
Wheat	Topdressing	Shijiazhuang	https://baijiahao.baidu.com/s?id=1862069614037809427&wfr=spider&for=pc
Wheat	Topdressing	Handan	https://m.thepaper.cn/baijiahao_30649625
Wheat	Topdressing	Zhoukou	https://www.ha.chinanews.com.cn/news/dfxw/2026/0403/67344.shtml
Wheat	Topdressing	Nanyang	https://mp.weixin.qq.com/s?__biz=MzIwNTc0MzM0OA==&mid=2247660527&idx=5&sn=66bc525c72f9cf348f5994ec96c5be98&chksm=96946a85c095d1a55f206d8b21d4bb5226713422c1cf9696517a2cf8e89ff2790f0aee9a5c4f&scene=27
Wheat	Topdressing	Shangqiu	https://news.cnr.cn/native/gd/kx/20250409/t20250409_527128517.shtml
Wheat	Topdressing	Zhumadian	https://www.zhumadian.gov.cn/zwyw/bmdt/202604/t20260403_695738.html
Wheat	Topdressing	Kaifeng	http://www.zmdnews.cn/2026/0408/843993.shtml
Wheat	Topdressing	Fuyang	https://www.gov.cn/yaowen/shipin/202504/content_7018392.htm
Wheat	Topdressing	Bozhou	http://vip.people.com.cn/albumsDetail?aid=1421775
Wheat	Topdressing	Yancheng	https://www.sheyang.gov.cn/art/2026/4/9/art_12119_4416465.html
Wheat	Topdressing	Xuzhou	https://www.agri.cn/zx/xxlb/js/202604/t20260410_8827148.htm https://phtv.ifeng.com/c/8s6VIML02Xo
Wheat	Topdressing	Huai'an	https://www.zgjssw.gov.cn/yaowen/202604/t20260404_8566880.shtml

Crop	Application Method	prefecture-level city	URL
Maize	Topdressing	Harbin	https://www.agri.cn/zx/xxlb/hlj/202607/t20260716_8854415.htm https://nyncw.sh.gov.cn/xyyw/20260713/c2fa90b5483f470cb67f40ef94c62929.html https://baijiahao.baidu.com/s?id=1872127093846675685&wfr=spider&for=pc
Maize	Topdressing	Heihe	https://mp.weixin.qq.com/s?__biz=MzAxNDAzNDQ2NA==&mid=2653243118&idx=5&sn=8dec1b5360115bcdf6e47f19efa4464d&chksm=8162eb12e181823426686102b0051ddb3d896c1f0c41999e6b6b8f924a85e4ab0a08d19d7f3a&scene=27 https://baijiahao.baidu.com/s?id=1870107065514522496&wfr=spider&for=pc
Maize	Topdressing	Suihua	http://www.amic.agri.cn/secondLevelPage/info/218/223706
Maize	Topdressing	Shuangyashan	https://baijiahao.baidu.com/s?id=1872127093846675685&wfr=spider&for=pc
Maize	Topdressing	Jixi	http://www.agri.cn/zx/xxlb/hlj/202607/t20260716_8854415.htm
Maize	Topdressing	Mudanjiang	https://mp.weixin.qq.com/s?__biz=MzAxNjY4MDgxOA==&mid=2651080407&idx=5&sn=b515f261a8c193c270fe6e48ff07a377&chksm=818ebd556f000ec2c02e163736ff6c4cc1812633e19d305a36ab5fc30748a57bf68c6a8296d3&scene=27
Maize	Topdressing	Qiqihar	https://baijiahao.baidu.com/s?id=1867032052323324208&wfr=spider&for=pc
Maize	Topdressing	Shijiazhuang	https://www.sohu.com/a/795597409_120333600
Maize	Topdressing	Cangzhou	https://baijiahao.baidu.com/s?id=1872150782463430361&wfr=spider&for=pc
Maize	Topdressing	Xingtai	https://nync.xingtai.gov.cn/news_show.aspx?id=4537
Maize	Topdressing	Hulunbuir	https://www.hlbe.gov.cn/News/show/1358993.html
Maize	Topdressing	Tongliao	http://nm.people.com.cn/BIG5/n2/2024/0708/c409108-40905132.html
Maize	Topdressing	Chifeng	http://nm.people.com.cn/n2/2026/0702/c406500-41627460.html
Maize	Topdressing	Songyuan	http://www.amic.agri.cn/secondLevelPage/info/311/206814
Maize	Topdressing	Siping	http://www.lishu.gov.cn/zw/zwxx/202607/t20260717_771137.html

Crop	Application Method	prefecture-level city	URL
Maize	Topdressing	Zhoukou	https://nyncj.zhoukou.gov.cn/sitesources/nyncj/page_pc/xwdt/snkx/article8fc98e419d1c4165afc5cc6718c0afa6.html
Maize	Topdressing	Shangqiu	https://www.sina.cn/news/detail/5326311971095300.html
Maize	Topdressing	Zhumadian	https://www.zmdtvw.cn/sannong/show-16-328494-0.html

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Table S5: Comparison of NH_3 emissions from major crops in China reported across different studies.

Base year	Total	References
2010	3.33	Xu et al. (2023)
2015	3.49	Wu et al. (2021)
2016	2.72	Li et al. (2021)
2017	2.09	Wang et al. (2021)
2017	3.01	Luo et al. (2025)
2018	3.27	Xu et al. (2021)
2018	3.46	Ma et al. (2022)
2019	2.73	Zhao et al. (2023)
2019	3.04	Li et al. (2024)
2020	2.9	Wang et al. (2025a)
2021	3.01	This study

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