**Table S1** Soil sampling information

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| --- | --- | --- | --- | --- | --- | --- |
| No. | Samples | Sites | Climate | Soil type | Land use | Vegetation |
| Chernozem (n=16) | | | | | | |
| Chernozem *Cropped land (n=9)* | | | | | | |
| 1 | B1 | Changchun, Jilin province | Humid continental climate | Chernozem soil | Cropped land | Vegetable |
| 2 | B2 | Shenyang, Heilongjiang province | Sub-humid continental climate | Chernozem soil | Cropped land | Vegetable |
| 3 | B3 | Zhangye, Gansu province | Temperate continental climate | Chernozem soil | Cropped land | Vegetable |
| 4 | B4 | Changchun, Jilin province | Humid continental climate | Chernozem soil | Cropped land | Maize |
| 5 | B5 | Changchun, Jilin province | Humid continental climate | Chernozem soil | Cropped land | Maize |
| 6 | B6 | Shenyang, Heilongjiang province | Sub-humid continental climate | Chernozem soil | Cropped land | Maize |
| 7 | B7 | Xining, Qinghai-Tibet Plateau | Frigid–temperate humid climate | Chernozem soil | Cropped land | Oilseed rape |
| 8 | B8 | Xining, Qinghai-Tibet Plateau | Frigid–temperate humid climate | Chernozem soil | Cropped land | Oilseed rape |
| 9 | B9 | Haidong, Qinghai-Tibet Plateau | Frigid–temperate humid climate | Chernozem soil | Cropped land | Oilseed rape |
| Chernozem *Natural land (n=7)* | | | | | | |
| 10 | B10 | Changchun, Jilin Province | Humid continental climate | Chernozem soil | Natural land | Grass |
| 11 | B11 | Changchun, Jilin Province | Humid continental climate | Chernozem soil | Natural land | Grass |
| 12 | B12 | Xining, Qinghai-Tibet Plateau | Frigid–temperate humid climate | Chernozem soil | Natural land | Grass |
| 13 | B13 | Xining, Qinghai-Tibet Plateau | Frigid–temperate humid climate | Chernozem soil | Natural land | Grass |
| 14 | B14 | Xining, Qinghai-Tibet Plateau | Frigid–temperate humid climate | Chernozem soil | Natural land | Grass |
| 15 | B15 | Zhangye, Gansu province | Temperate continental climate | Chernozem soil | Natural land | Grass |
| 16 | B16 | Zhangye, Gansu province | Temperate continental climate | Chernozem soil | Natural land | Grass |
| Cinnamon soil (n=14) | | | | | | |
| Cinnamon soil *Cropped land (n=9)* | | | | | | |
| 17 | C1 | Huairou, Beijing | Temperate monsoon climate | Cinnamon soil | Cropped land | Maize |
| 18 | C2 | Huairou, Beijing | Temperate monsoon climate | Cinnamon soil | Cropped land | Vegetable |
| 19 | C3 | Chaoyang, Beijing | Temperate monsoon climate | Cinnamon soil | Cropped land | Maize |
| 20 | C4 | Chaoyang, Beijing | Temperate monsoon climate | Cinnamon soil | Cropped land | Vegetable |
| 21 | C5 | Tangshan, Hebei province | Temperate monsoon climate | Cinnamon soil | Cropped land | Maize |
| 22 | C6 | Tangshan, Hebei province | Temperate monsoon climate | Cinnamon soil | Cropped land | Vegetable |
| 23 | C7 | Tangshan, Hebei province | Temperate monsoon climate | Cinnamon soil | Cropped land | Maize |
| 24 | C8 | Jining, Shandong province | Temperate monsoon climate | Cinnamon soil | Cropped land | Maize |
| 25 | C9 | Jining, Shandong province | Temperate monsoon climate | Cinnamon soil | Cropped land | Maize |
| Cinnamon soil *Natural land (n=5)* | | | | | | |
| 26 | C10 | Jining, Shandong province | Temperate monsoon climate | Cinnamon soil | Natural land | Natural land |
| 27 | C11 | Zhengzhou, Henan province | Temperate monsoon climate | Cinnamon soil | Natural land | Grass |
| 28 | C12 | Zhengzhou, Henan province | Temperate monsoon climate | Cinnamon soil | Natural land | Natural land |
| 29 | C13 | Jinzhong, Shanxi province | Temperate monsoon climate | Cinnamon soil | Natural land | Grass |
| 30 | C14 | Jinzhong, Shanxi province | Temperate monsoon climate | Cinnamon soil | Natural land | Natural land |
| Paddy soil (n=18) | | | | | | |
| 31 | P1 | Guilin, Guangxi province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 32 | P2 | Guilin, Guangxi province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 33 | P3 | Fuzhou, Fujian province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 34 | P4 | Huaining, Anhui province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 35 | P5 | Qiyang, Hunan province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 36 | P6 | Qiyang, Hunan province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 37 | P7 | Qiyang, Hunan province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 38 | P8 | Tongren, Guizhou province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 39 | P9 | Tongren, Guizhou province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 40 | P10 | Tongren, Guizhou province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 41 | P11 | Nanchang, Jiangxi province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 42 | P12 | Nanchang, Jiangxi province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 43 | P13 | Chengdu, Sichuan province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 44 | P14 | Chengdu, Sichuan province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 45 | P15 | Guangzhou, Guangdong province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 46 | P16 | Guangzhou, Guangdong province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 47 | P17 | Guangzhou, Guangdong province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| 48 | P18 | Anqing, Anhui province | Subtropical monsoon climate | Paddy soil | Cropped land | Rice |
| Red soil (n=11) | | | | | | |
| Red soil *Cropped land (n=7)* | | | | | | |
| 49 | R1 | Kunming, Yunnan province | Subtropical monsoon climate | Red soil | Cropped land | Vegetable |
| 50 | R2 | Kunming, Yunnan province | Subtropical monsoon climate | Red soil | Cropped land | Vegetable |
| 51 | R3 | Qiyang, Hunan province | Subtropical monsoon climate | Red soil | Cropped land | Vegetable |
| 52 | R4 | Qiyang, Hunan province | Subtropical monsoon climate | Red soil | Cropped land | Vegetable |
| 53 | R5 | Shangrao, Jiangxi province | Subtropical monsoon climate | Red soil | Cropped land | Vegetable |
| 54 | R6 | Tongren, Guizhou province | Subtropical monsoon climate | Red soil | Cropped land | Vegetable |
| 55 | R7 | Tongren, Guizhou province | Subtropical monsoon climate | Red soil | Cropped land | Vegetable |
| Red soil *Natural land (n=4)* | | | | | | |
| 56 | R8 | Kunming, Yunnan province | Subtropical monsoon climate | Red soil | Natural land | Natural land |
| 57 | R9 | Kunming, Yunnan province | Subtropical monsoon climate | Red soil | Natural land | Natural land |
| 58 | R10 | Shangrao, Jiangxi province | Subtropical monsoon climate | Red soil | Natural land | Natural land |
| 59 | R11 | Nanchang, Jiangxi province | Subtropical monsoon climate | Red soil | Natural land | Natural land |

n, number of soil samples.