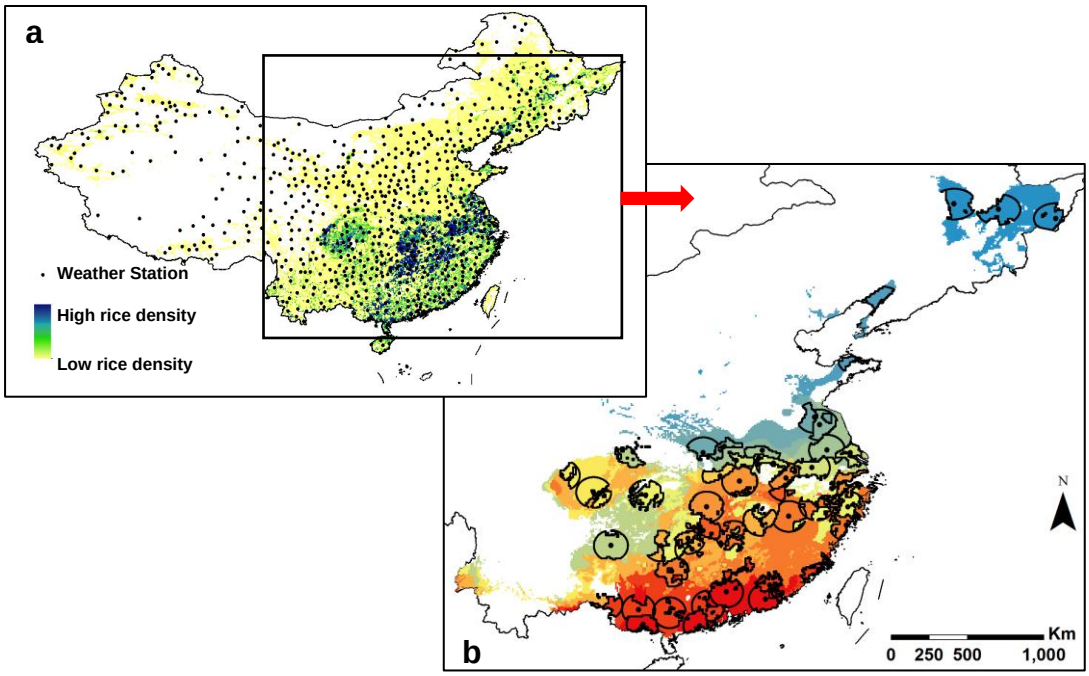
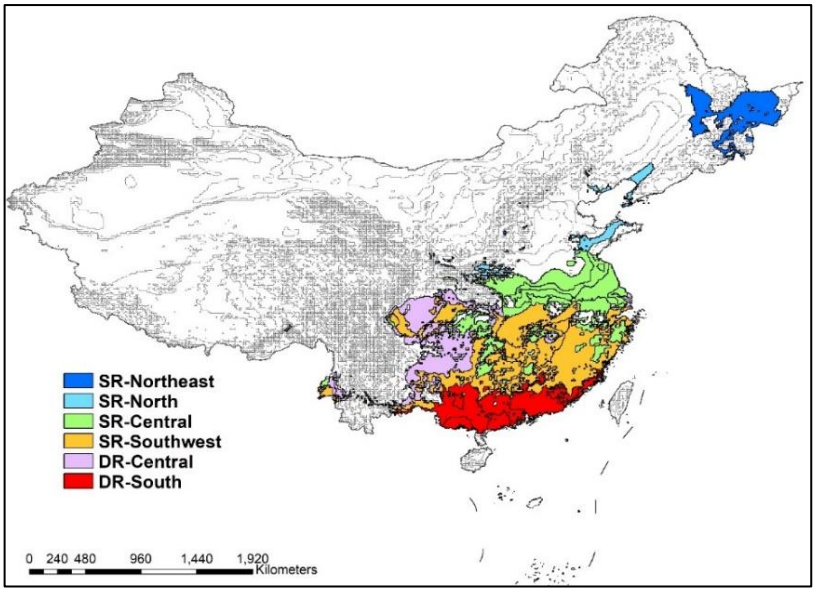
# Supplementary Information

## Closing yield gaps for rice self-sufficiency in China

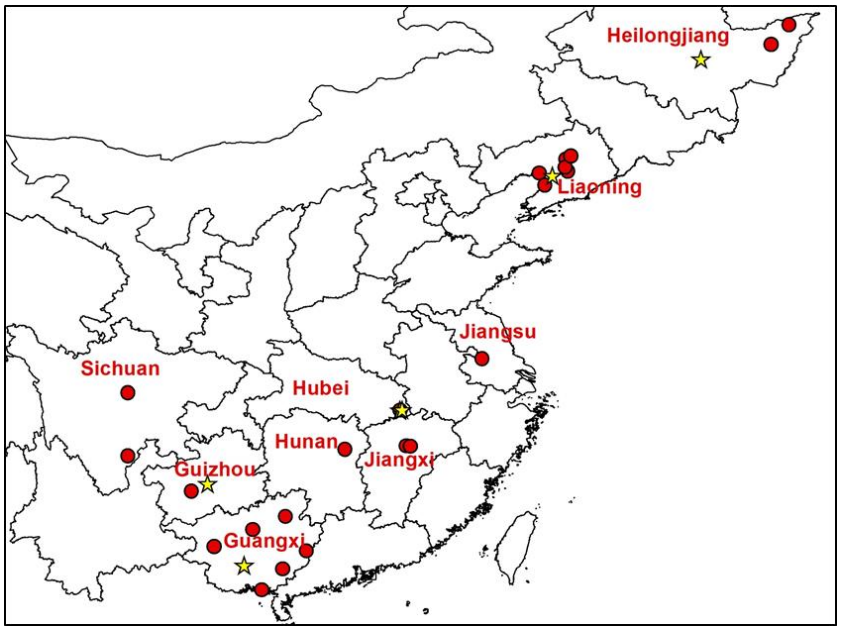
Deng *et al.*



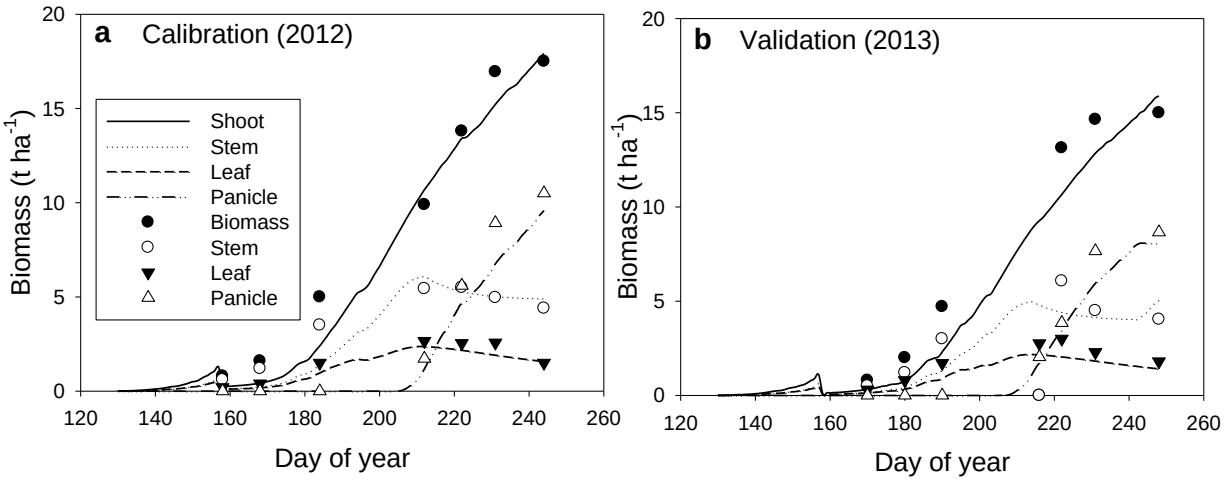

**Supplementary Figure 1. Selected reference weather stations (RWS) and climate zones (CZ). a**, Locations of 836 weather stations (dots) from the China Meteorological Administration weather database (National Meteorological Information Center, http://data.cma.cn), and rice harvested area density (SPAM map)[1]. **b**, Selected RWS (black dots), borders of RWS buffers (black lines), and CZ (different colors) in China. In total, 50 RWS were selected in northeast, north, central, and south China, accounting for 48% of national rice harvested area within RWS buffer zones. The 50 selected RWS are located in 16 CZ, which, in turn, account for 85% of national rice harvested area. Source data are provided as a Source Data file.



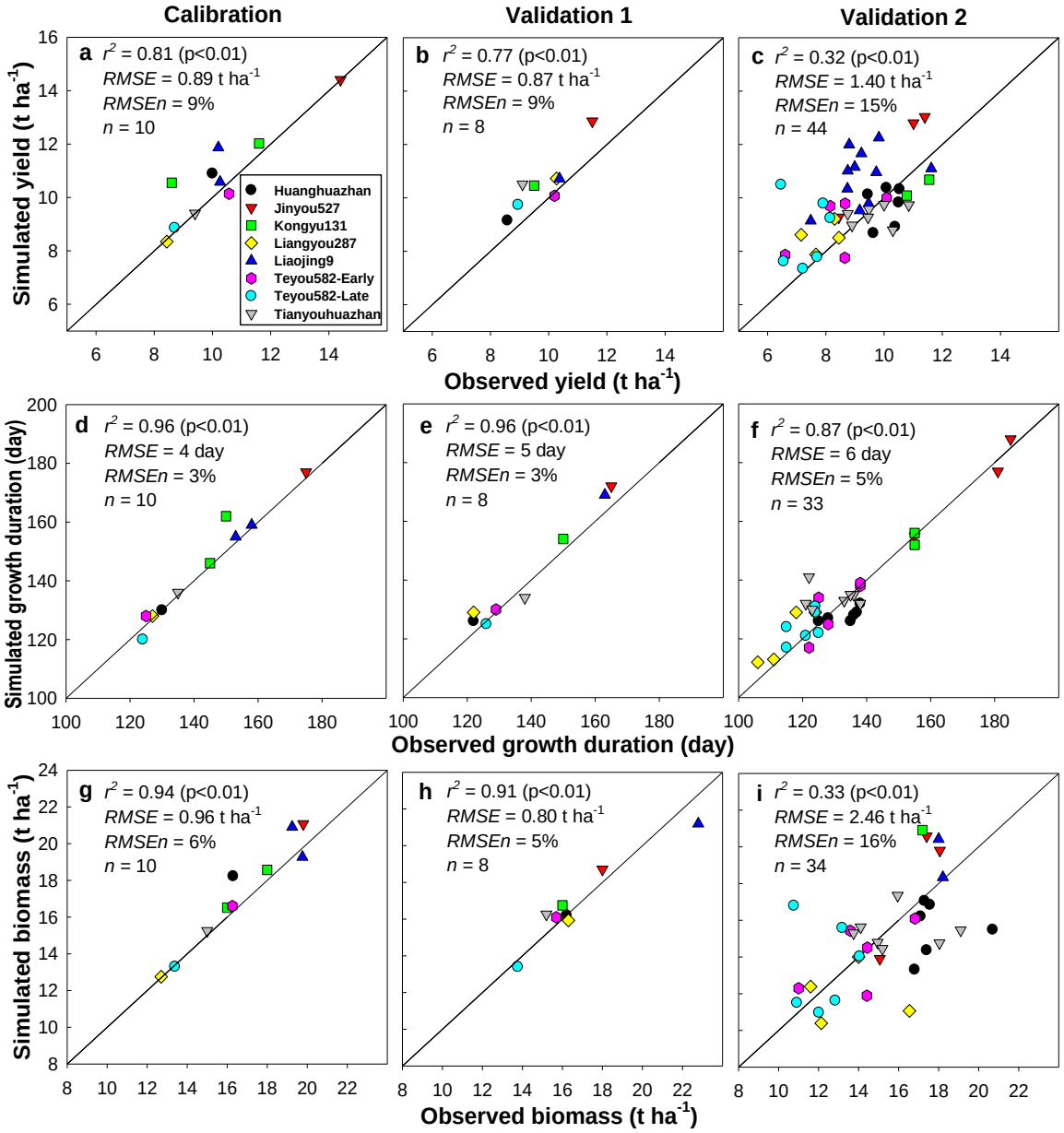

**Supplementary Figure 2. Six rice production regions and dominant rice cropping system in each region.** Black lines in the background outline the 139 climate zones in China; of these, 16 climate zones covering 85% of rice growing areas are colored, with each color corresponding to one of the six production regions delineated for selection of dominant management practices and cultivars. For the purpose of simulating potential yield, crop management practices, including rice cropping system, cultivar and sowing date, are considered to be similar within each region, which may contain from 1 to 5 climate zones. Source data are provided as a Source Data file.



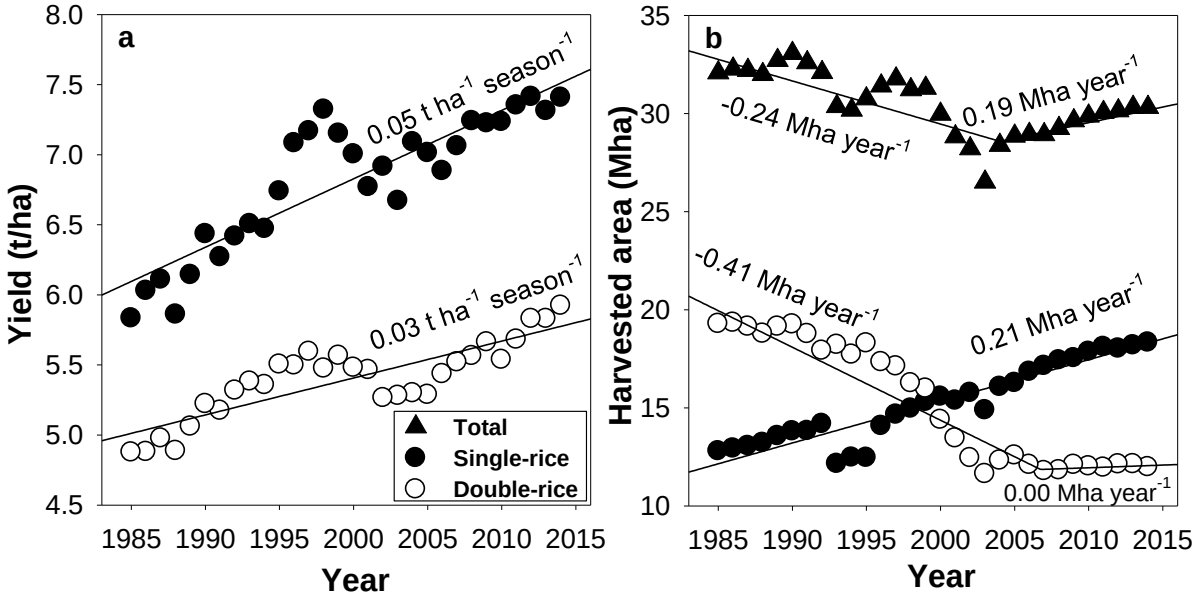

**Supplementary Figure 3. Experimental sites for ORYZA model calibration and validation.** Yellow stars are the calibration and validation 1 experimental sites (n=6), and red points are the validation 2 experimental sites (n=23). The related names of provinces are shown in red. Source data are provided as a Source Data file.



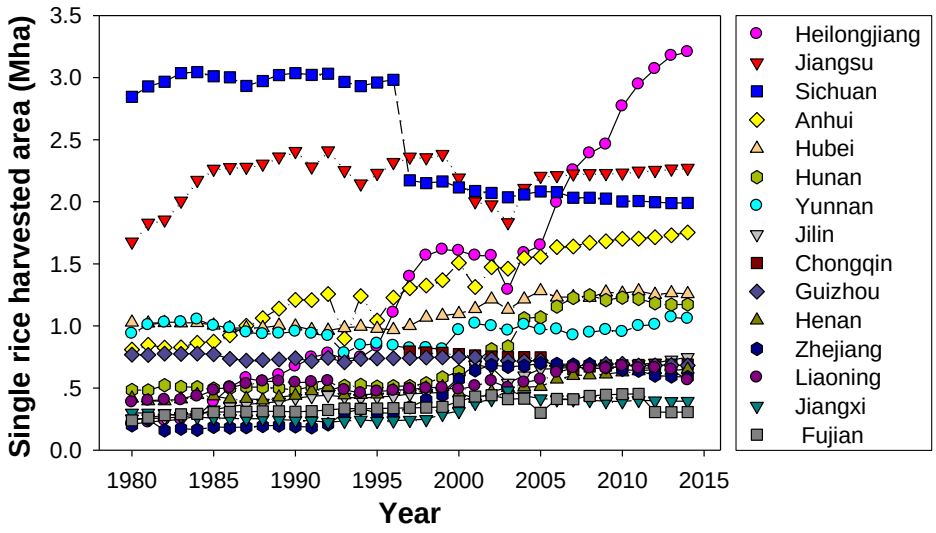

**Supplementary Figure 4. ORYZA rice model calibration results for rice cultivar Huanghuazhan.** Comparison of (**a**) calibrated (2012) and (**b**) validated (2013) results of rice cultivar Huanghuazhan by using ORYZA rice model. Simulated (lines) and observed values (symbols) are shown for shoot (i.e., aboveground biomass), green leaf, stem, and panicle biomass. Source data are provided as a Source Data file.



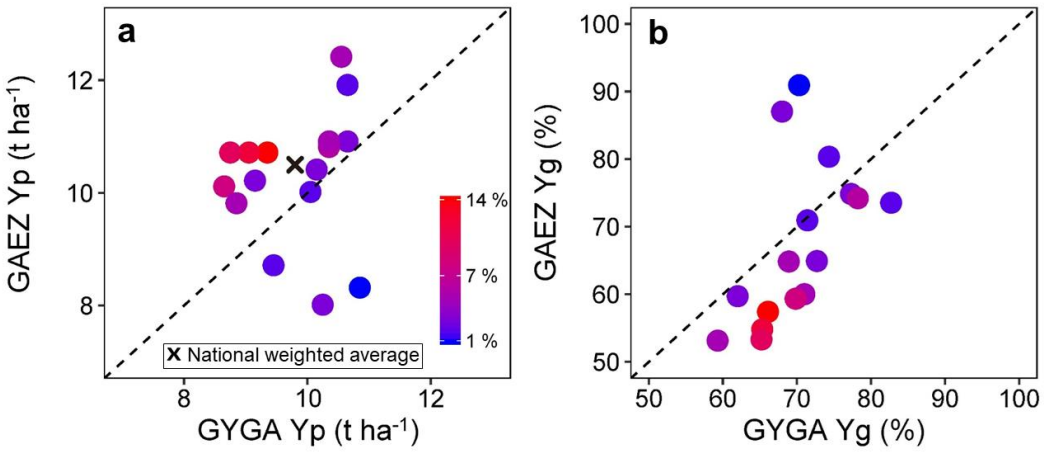

**Supplementary Figure 5. ORYZA rice model calibration and validation.** Comparison of calibrated versus observed grain yield (**a**), aboveground biomass (**d**), and growth duration (**g**), validated dataset 1 (data were from same experimental sites or same paper as calibration dataset) versus observed grain yield (**b**), shoot biomass (**e**) and growth duration (**h**) and validated dataset 2 (data were from different experimental sites or different paper as calibration dataset) versus observed grain yield (**c**), shoot biomass (**f**) and growth duration (**i**) by using calibrated ORYZA rice model. Symbols with same colors represent the same cultivar grown in different years or sites. Line in each figure is the 1 to 1 line. Data were collected from experimental site (Huanghuazhan in central China) and from high-yield experiments in published papers. Source data are provided as a Source Data file.




**Supplementary Figure 6. Trends in national average rice yield (a) and harvested area (b) in China.** The data were disaggregated by total- (single and double), single- and double-rice crop production systems. Note that yields for double-rice are the average for the two rice crops grown each year in the same field so that total rice output per hectare is twice the values shown. Data were obtained from NBSC[2]. Mha: million hectares. Source data are provided as a Source Data file.




**Supplementary Figure 7. Trends in rice harvested area of single-rice by province since 1980.** Data were obtained from NBSC[2]. Mha: million hectares. Source data are provided as a Source Data file.




**Supplementary Figure 8. Comparison of Yp and Yg between GYGA and GAEZ.** Comparison of (**a**) Yp and (**b**) Yg (Ya/Yp %) estimated by GYGA (Global Yield Gap Atlas) and GAEZ (Global Agro-ecological Zones)[3] at CZ level by weighting irrigated rice harvested area based on the SPAM map. Each observation represents one of the 16 major rice-growing CZs, and the different symbol colors represent the percentage of national rice harvested area contained within each CZ. Yp: potential yield; Ya: farm yield; Yg: yield gap. Source data are provided as a Source Data file.

**Supplementary Table 1. Location for the reference weather stations used in this study**

| RWS ID | County, Province | Longitude (º) | Latitude (º) | Elevation (m) | Cropping system* |
|---|---|---|---|---|---|
| 1 | Xiangfan, Hubei | 112.2 | 32.0 | 70 | Single-rice |
| 2 | Muyang, Jiangsu | 118.8 | 34.1 | 9 | Single-rice |
| 3 | Tongbai, Henan | 113.4 | 32.4 | 149 | Single-rice |
| 4 | Huaiyin, Jiangsu | 119.0 | 33.7 | 15 | Single-rice |
| 5 | Gushi, Henan | 115.7 | 32.2 | 58 | Single-rice |
| 6 | Dantu, Jiangsu | 119.5 | 32.2 | 29 | Single-rice |
| 7 | Dawu, Hubei | 114.1 | 31.6 | 72 | Single-rice |
| 8 | Nantong, Jiangsu | 120.9 | 32.0 | 6 | Single-rice |
| 9 | Huoshan, Anhui | 116.3 | 31.4 | 73 | Single-rice |
| 10 | Wuhu, Anhui | 118.6 | 31.2 | 20 | Single-rice |
| 11 | Qianjiang, Chongqing | 108.8 | 29.5 | 609 | Single-rice |
| 12 | Chengbu, Hunan | 111.5 | 26.4 | 476 | Single-rice |
| 13 | Xianju, Zhejiang | 120.7 | 28.9 | 52 | Single-rice |
| 14 | Wanyuan, Sichuan | 108.0 | 32.1 | 674 | Single-rice |
| 15 | Guiyang, Guizhou | 106.7 | 26.6 | 1074 | Single-rice |
| 16 | Wenjiang, Sichuan | 103.8 | 30.7 | 541 | Single-rice |
| 17 | Dazu, Chongqing | 105.7 | 29.7 | 394 | Single-rice |
| 18 | Jingan, Jiangxi | 115.4 | 28.9 | 80 | Single-rice |
| 19 | Haicheng, Liaoning | 122.7 | 40.9 | 27 | Single-rice |
| 20 | Fushan, Shandong | 121.3 | 37.5 | 34 | Single-rice |
| 21 | Suihua, Heilongjiang | 127.0 | 46.6 | 180 | Single-rice |
| 22 | Yilan, Heilongjiang | 129.6 | 46.3 | 101 | Single-rice |
| 23 | Hulin, Heilongjiang | 133.0 | 45.8 | 104 | Single-rice |
| 24 | Tianmen, Hubei | 113.2 | 30.7 | 35 | Double-rice |
| 25 | Jingzhou, Hunan | 109.7 | 26.6 | 321 | Double-rice |
| 26 | Shaoyang, Hunan | 111.3 | 27.0 | 278 | Double-rice |
| 27 | Cixi, Zhejiang | 121.3 | 30.2 | 8 | Double-rice |
| 28 | Jinhua, Zhejiang | 119.7 | 29.1 | 65 | Double-rice |
| 29 | Zhangshu, Jiangxi | 115.6 | 28.1 | 30 | Double-rice |
| 30 | Jiangxia, Hubei | 114.3 | 30.4 | 38 | Double-rice |
| 31 | Yuanjiang, Hunan | 112.4 | 28.9 | 36 | Double-rice |
| 32 | Anqing, Anhui | 117.1 | 30.5 | 20 | Double-rice |
| 33 | Hangzhou, Zhejiang | 120.2 | 30.2 | 43 | Double-rice |
| 34 | Lianhua, Jiangxi | 114.0 | 27.1 | 181 | Double-rice |
| 35 | Guilin, Guangxi | 110.3 | 25.1 | 172 | Double-rice |
| 36 | Guixi, Jiangxi | 117.2 | 28.3 | 52 | Double-rice |
| 37 | Quzhou, Zhejiang | 118.9 | 29.0 | 67 | Double-rice |
| 38 | Ruian, Zhejiang | 120.6 | 27.8 | 10 | Double-rice |
| 39 | Shuangfeng, Hunan | 112.2 | 27.5 | 98 | Double-rice |
| 40 | Dongzhi, Anhui | 117.0 | 30.1 | 23 | Double-rice |
| 41 | Nanxiong, Guangdong | 114.3 | 25.1 | 135 | Double-rice |
| 42 | Xianyou, Fujian | 118.7 | 25.4 | 77 | Double-rice |
| 43 | Meixian, Guangdong | 116.1 | 24.3 | 89 | Double-rice |
| 44 | Gaoyao, Guangdong | 112.5 | 23.1 | 12 | Double-rice |
| 45 | Nanning, Guangxi | 108.4 | 22.8 | 74 | Double-rice |
| 46 | Yulin, Guangxi | 110.2 | 22.7 | 85 | Double-rice |
| 47 | Fogang, Guangdong | 113.5 | 23.9 | 68 | Double-rice |
| 48 | Jiexi, Guangdong | 115.8 | 23.4 | 42 | Double-rice |
| 49 | Qinzhou, Guangxi | 108.6 | 22.0 | 6 | Double-rice |
| 50 | Yangjiang, Guangdong | 112.0 | 21.9 | 22 | Double-rice |

*Dominant rice cropping system, with either one (single-) or two (double-) rice crops per year. Dominant cropping system (single- or double-rice) identified for each RWS buffer was used as the basis for simulation of potential yield and estimation of yield gaps.

**Supplementary Table 2. Crop management information for each of the six rice-production regions and data source for calibration and validation of the ORYZA rice model**

| Calibration infomation | Kongyu 131 | Liaojing9 | Huang huazhan | Jinyou 527 | Liang you287 | Tianyou huazhan | Teyou 582 | Teyou 582 |
|---|---|---|---|---|---|---|---|---|
| Region | Northeast | North | Central | South-west | Central | Central | Southern | Southern |
| Cropping system | Single | Single | Single | Single | Double-early | Double-late | Double-early | Double-late |
| Growth duration (d) | 130-145 | 150-160 | 115-125 | 155-170 | 115-130 | 115-135 | 115-135 | 105-120 |
| Calibration and Validation 1 | | | | | | | | |
| Site:Province (county) | Heilong jiang (Yilan) | Liaoning (Haicheng) | Hubei (Wuxue) | Guizhou (Guiyang) | Hubei (Wuxue) | Hubei (Wuxue) | Guangxi (Nanning) | Guangxi (Nanning) |
| Location (Long., lat. Elevation) | 129.6, 46.3, 101m | 122.7, 40.9, 27m | 115.03, 30.3, 198m | 106.7, 26.6, 1074m | 114.3, 30.4, 41m | 114.3, 30.4, 41m | 108.4, 22.8, 74m | 114.3, 30.4, 41m |
| Calibration year | 2010, 2012 | 2006-2007, 2009 | 2012 | 2008 | 2014 | 2013 | 2010 | 2010 |
| Validation 1 year | 2011 | 2006-2007 | 2013 | 2009 | 2013 | 2012 | 2011 | 2011 |
| Reference | (4-5) | (8-9) | Experiment | (18) | (17, 20) | (17, 22) | (26) | (26) |
| Validation 2 | | | | | | | | |
| Station site: province (country) | Heilong jiang (Fujing) | Liaoning (Dawu, Sunjiatun, Liaoyang, Doingling, Gaixian, Shengyang) | Hunan (Changsha), Hubei (Wuxue) | Guizhou (Anshun), Sichuan (Xichang, Ya'an) | Hubei (Wuxue) | Jiangxi (Jinxian, Nanchang), Jiangsu (Yangzhou), Hubei (Wuxue) | Guangxi (Guilin, Hechi, Wuzhou, Baise, Yulin) | Guangxi (Wuzhou, Hepu, Baise, Nanning) |
| Year | 2007, 2010 | 2005-2007 | 2012-2015 | 2008-2009 | 2013-2015 | 2008, 2010, 2013-2015 | 2010-2011 | 2010-2012 |
| Datasets reference | (6-7) | (9-15) | (16-17) | (18-19) | (17, 21-22) | (17, 21, 23-25) | (26) | (26-27) |

**Supplementary Table 3. Modifications and calibrations to key parameters in ORYZA rice model**

| Calibration information | Kongyu 131 | Liaojing9 | Huang huazhan | Jinyou 527 | Liangyou 287 | Tianyou Huazhan | Teyou 582 | Teyou 582 |
|---|---|---|---|---|---|---|---|---|
| TMD | 42.0 | 42.0 | 42.6 | 42.0 | 42.6 | 42.6 | 42.6 | 42.6 |
| TOD | 30.00 | 30.00 | 31.17 | 30.00 | 31.17 | 31.17 | 31.17 | 31.17 |
| COLDEAD (d) | 20 | 10 | 5 | 10 | 10 | 5 | 10 | 5 |
| DVRJ | 0.0011770 | 0.0009228 | 0.0007659 | 0.0007600 | 0.0015291 | 0.0007553 | 0.0010964 | 0.0011770 |
| DVRI | 0.0007576 | 0.0007576 | 0.0008076 | 0.0007580 | 0.0007576 | 0.0007576 | 0.0007576 | 0.0007576 |
| DVRP | 0.0005697 | 0.0007007 | 0.0007698 | 0.0006640 | 0.0008615 | 0.0007692 | 0.0006465 | 0.0005697 |
| DVRR | 0.0016832 | 0.0015550 | 0.0016842 | 0.0014910 | 0.0020298 | 0.0015905 | 0.0019714 | 0.0016832 |
| FSTR | 0.35 | 0.10 | 0.20 | 0.33 | 0.36 | 0.15 | 0.38 | 0.20 |
| FSH0.00 | 0.50 | 0.50 | 0.60 | 0.50 | 0.70 | 0.50 | 0.70 | 0.50 |
| FSH0.43 | 0.65 | 0.65 | 0.72 | 0.50 | 0.75 | 0.65 | 0.75 | 0.50 |
| FSH1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| FLV0.00 | 0.60 | 0.30 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| FLV0.44 | 0.50 | 0.30 | 0.40 | 0.32 | 0.40 | 0.40 | 0.50 | 0.40 |
| FLV0.64 | 0.40 | 0.40 | 0.40 | 0.37 | 0.40 | 0.30 | 0.40 | 0.30 |
| FLV0.90 | 0.30 | 0.40 | 0.30 | 0.32 | 0.30 | 0.30 | 0.30 | 0.30 |
| FLV1.00 | 0.30 | 0.10 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.20 |
| FLV1.16 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FLV1.49 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FST0.00 | 0.40 | 0.70 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| FST0.44 | 0.50 | 0.70 | 0.60 | 0.68 | 0.60 | 0.60 | 0.50 | 0.60 |
| FST0.64 | 0.60 | 0.60 | 0.60 | 0.63 | 0.60 | 0.70 | 0.60 | 0.70 |
| FST0.90 | 0.70 | 0.60 | 0.70 | 0.68 | 0.70 | 0.70 | 0.70 | 0.70 |
| FST1.00 | 0.00 | 0.30 | 0.00 | 0.00 | 0.00 | 0.30 | 0.00 | 0.30 |
| FST1.16 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FST1.49 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FSO0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FSO0.44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FSO0.64 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FSO0.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FSO1.00 | 0.70 | 0.60 | 1.00 | 1.00 | 1.00 | 0.50 | 1.00 | 0.50 |
| FSO1.16 | 1.00 | 0.60 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| FSO1.49 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

**Supplementary Table 4. Description of the calibrated model parameters in Supplementary Table 3**

| Parameter | Description | Parameter | Description |
|---|---|---|---|
| TMD | Maximum temperature for development ($^oC$) | FLV1.16 | Fraction shoot dry matter partitioned to leaves at DVS = 1.16 |
| TOD | Optimum temperature for development ($^oC$) | FLV1.49 | Fraction shoot dry matter partitioned to leaves at DVS = 1.49 |
| COLDEAD | Consecutive number of days below COLDMIN that crop dies | FSTR | Fraction of carbohydrates allocated to stems that is stored as reserves |
| DVRJ | Development rate in juvenile phase ($^oCd^{-1}$) | FST0.00 | Fraction shoot dry matter partitioned to stems at DVS = 0 |
| DVRI | Development rate in photoperiod-sensitive phase ($^oCd^{-1}$) | FST0.44 | Fraction shoot dry matter partitioned to stems at DVS = 0.44 |
| DVRP | Development rate in panicle development ($^oCd^{-1}$) | FST0.64 | Fraction shoot dry matter partitioned to stems at DVS = 0.64 |
| DVRR | Development rate in reproductive phase ($^oCd^{-1}$) | FST0.90 | Fraction shoot dry matter partitioned to stems at DVS = 0.9 |
| DVS | Development stage (DVS = 0: sowing; 0.4: photoperiod-sensitive phase; 0.65: panicle initiation; 1: flowering; 2: physiological maturity) | FST1.00 | Fraction shoot dry matter partitioned to stems at DVS = 1 |
| FSTR | Fraction of carbohydrates allocated to stems that is stored as reserves (-) | FST1.16 | Fraction shoot dry matter partitioned to stems at DVS = 1.16 |
| FSH0.00 | Fraction total dry matter partitioned to shoot at DVS = 0 | FST1.49 | Fraction shoot dry matter partitioned to stems at DVS = 1.49 |
| FSH0.43 | Fraction total dry matter partitioned to shoot at DVS = 0.43 | FSO0.00 | Fraction shoot dry matter partitioned to panicles at DVS = 0 |
| FSH1.00 | Fraction total dry matter partitioned to shoot at DVS = 1 | FSO0.44 | Fraction shoot dry matter partitioned to panicles at DVS = 0.44 |
| FLV0.00 | Fraction shoot dry matter partitioned to leaves at DVS = 0 | FSO0.64 | Fraction shoot dry matter partitioned to panicles at DVS = 0.64 |
| FLV0.44 | Fraction shoot dry matter partitioned to leaves at DVS = 0.44 | FSO0.90 | Fraction shoot dry matter partitioned to panicles at DVS = 0.9 |
| FLV0.64 | Fraction shoot dry matter partitioned to leaves at DVS = 0.64 | FSO1.00 | Fraction shoot dry matter partitioned to panicles at DVS = 1 |
| FLV0.90 | Fraction shoot dry matter partitioned to leaves at DVS = 0.9 | FSO1.16 | Fraction shoot dry matter partitioned to panicles at DVS = 1.16 |
| FLV1.00 | Fraction shoot dry matter partitioned to leaves at DVS = 1 | FSO1.49 | Fraction shoot dry matter partitioned to panicles at DVS = 1.49 |

**Supplementary Table 5. Summary of model calibration and validation efforts in previous studies simulating rice potential yield**

| Source | Study Case | Model | No. of sites for calibration | No. of cultivars for calibration | No. of validation data sets | Data source |
|---|---|---|---|---|---|---|
| Current study | China | ORYZA | 6 | 7 | 52 | Research papers and high-yield experiments (2005-2015) |
| (28) | China | ORYZA | NA* | Default** | NA | NA |
| (29) | China | ORYZA | 19 | 25 | 69 | CMA (1998-2009)*** |
| (30) | China | MCWLA-Rice**** | NA | NA | NA | Statistical yearbook |
| (31) | China | CERES-Rice | NA | NA | 119 | CMA (2003-2004) |
| (32) | Indonesia | ORYZA | 3 | 1 | 21 | High-yield experiments |
| (33) | Indonesia | ORYZA | 1 | Default | NA | NA |
| (34) | Indonesia | ORYZA | 1 | NA | NA | NA |
| (34) | Myanmar | ORYZA | 1 | NA | NA | NA |
| (33) | Philippines | ORYZA | 1 | Default | NA | NA |
| (33) | Thailand | ORYZA | 1 | Default | NA | NA |
| (34) | Thailand | ORYZA | 1 | NA | NA | NA |
| (35) | USA | ORYZA | 10 | 2 | NA | Experimental plots |
| (33) | Vietnam | ORYZA | 1 | Default | NA | NA |
| (34) | Vietnam | ORYZA | 1 | NA | NA | NA |
| (36) | African countries(8) | ORYZA | NA | NA | NA | NA |

* NA: Not clearly mentioned in the paper.

**Default: default parameter value used in absence of calibration.

*** In the MCWLA-Rice model, calibration is done by Bayesian probability inversion and the MCMC technique[37].

**** CMA: China Meteorological Administration. Notice that, within the year range of the calibration database in the paper, 89% of the yields are before 2005.

**Supplementary Table 6. Data source and uncertainties and quality control measures**

| Data | Data source | Uncertainties and/or limitations | Quality control measures |
|---|---|---|---|
| Weather data | CMA | Erroneous and missing data | Quality control following van Wart et al (2013)[28], Grassini et al. (2015)[38], and Global Yield Gap Atlas (http://www.yieldgap.org) |
| Average yield data, total production, and harvested area | NBSC | Possible yield bias at county level due to sample size | Adjusted to ensure consistency with provincial and national yield records |
| Experimental data for model calibration and validation | Original and published data | Not all experiments were not necessarily managed to reach potential yield or lack of detailed information for the experiments that reached potential yield | Selection of well management, high yield experiments for model calibration |
| Rice area distribution | SPAM | Crop area distribution around year 2005 may be outdated | Selection of high number of RWS across the entire rice producing region reduces the potential bias |

Abbreviation: CMA: National Meteorological Information Center of the China Meteorological Administration; NBSC: National Bureau of Statistics of China.

**Supplementary Table 7. Previous studies assessing rice production scenarios in China**

| Scenario | Projection Year | Self-sufficiency ratio | Reference |
|---|---|---|---|
| S1 | 2030 | 95% | Current study |
| S2 | 2030 | 100% | Current study |
| S3 | 2030 | 99% | Current study |
| S4 | 2030 | 100% | Current study |
| Ya increased by the yield trend from 1985 to 2014 | 2030 | 100% | (39) |
| Ya reaches to 80% Yield of ISSM* | 2030 | 99% | (39) |
| Grain price fall + slightly import (2025) | 2025 | 90% | (40) |
| A2** | 2011-2040 (average) | 100% | (41) |
| A2 + $CO_2$ fertilization | 2011-2040 (average) | 100% | (41) |
| B2 | 2011-2040 (average) | 100% | (41) |
| B2 + $CO_2$ fertilization | 2011-2040 (average) | 100% | (41) |
| A2 | 2030 | 92% | (42) |
| A2 + tech | 2030 | 95% | (42) |
| B2 + no tech | 2030 | 100% | (42) |
| B2 + tech | 2030 | 100% | (42) |
| Integration of biological mechanisms with economic mechanisms | 2024 | 93% | (43) |
| -*** | 2027 | 97% | (44) |
| Projection of import and export in 2025 | 2025 | 100% | (45) |

*ISSM is an integrated soil-crop system management including optimization of varieties, sowing dates, densities and advanced nutrient management.

** A2 and B2: IPCC SRES A2 and B2 scenarios in 2030/2050; “tech” means technology development.

*** No detailed information for the assessment scenario

**Supplementary Table 8. Estimated potential total production if all rice farmers achieved yields that were 80% of potential exploitable production as estimated by protocols developed by GYGA or by GAEZ**

| Method | Exploitable production (MMT) | Increase over current production (206 MMT) (MMT) | Increase over production demand in 2030 (217 MMT) (MMT) |
|---|---|---|---|
| GYGA* | 237 | 31 | 20 |
| GAEZ | 254 | 48 | 37 |

* GYGA: Global Yield Gap Atlas; GAEZ: Global Agro-Ecological Zones Model. Source data are provided as a Source Data file.

## Supplementary References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