

## Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Research policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

### Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a Confirmed

- ☐ ☒ The exact sample size ( $n$ ) for each experimental group/condition, given as a discrete number and unit of measurement
- ☐ ☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
- ☐ ☒ The statistical test(s) used AND whether they are one- or two-sided  
*Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
- ☒ ☐ A description of all covariates tested
- ☒ ☐ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
- ☐ ☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
- ☐ ☒ For null hypothesis testing, the test statistic (e.g.  $F$ ,  $t$ ,  $r$ ) with confidence intervals, effect sizes, degrees of freedom and  $P$  value noted  
*Give  $P$  values as exact values whenever suitable.*
- ☒ ☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
- ☒ ☐ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
- ☒ ☐ Estimates of effect sizes (e.g. Cohen's  $d$ , Pearson's  $r$ ), indicating how they were calculated

*Our web collection on [statistics for biologists](#) contains articles on many of the points above.*

### Software and code

Policy information about [availability of computer code](#)

#### Data collection

Data on national rice yield, area, production, export, and import were download from FAOSTAT, data on rice distribution were downloaded from SPAM map, data on population size were downloaded from UN, data on the current per-capita rice demand were downloaded from USDA, data on relative change in per-capita rice demand were retrieved from publishes studies, data on genetic coefficient and dominate crop management practices used for yield potential simulation were provided by agricultural specialists, data on average farmer yields were retrieved from official statistics in each country, and data on daily weather were collected from the local weather stations and NASA-POWER.

#### Data analysis

Statistix 8, SigmaPlot 14.0, and ArcGIS 10.8 were used for statistical analysis.

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research [guidelines for submitting code & software](#) for further information.

### Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

Data on national rice yield, area, production, export, and import from FAOSTAT are available at [www.fao.org/faostat](http://www.fao.org/faostat). Data on rice distribution from SPAM map are available at [www.mapspam.info](http://www.mapspam.info). Data on population size from UN are available at <https://population.un.org/wpp/>. Data on the current per-capita rice demand from USDA are available at <https://apps.fas.usda.gov/psdonline/app/index.html#/app/advQuery>. Data on daily weather from NASA-POWER are available at <https://power.larc.nasa.gov/>.

## Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

## Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

|                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Study description                 | We assess yield potential and yield gap of irrigated and rainfed lowland rice across the six major rice-producing countries (together accounting for 97% of total regional rice production) in Southeast Asia and determine rice self-sufficiency ratio and rice surplus for each of the six countries and the Southeast Asia as a whole by 2040 under different exploitable yield gap closure scenarios.                                                                                                                                                                                                                                                                          |
| Research sample                   | Our study includes a total of 11 country-water regime combinations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Sampling strategy                 | We include a total of 182 reference weather station buffer-cropping system combinations by following Global Yield Gap Atlas protocol within six major rice-producing countries, which together account for 97% of the regional total rice production and harvested area in Southeast Asia. The 182 reference weather station buffer-cropping system combinations encompassed a wide range of biophysical and socio-economic context in Southeast Asia.                                                                                                                                                                                                                             |
| Data collection                   | Data on rice yield, area, production, export, and import were from FAOSTAT, data on rice distribution were from SPAM map, data on population size were from UN, data on the current per-capita rice demand were from USDA, data on relative change in per-capita rice demand were from publishes studies, data on genetic coefficient and dominate crop management practices used for yield potential simulation were from agricultural specialists, and data on daily weather were from the local weather stations and NASA-POWER.                                                                                                                                                |
| Timing and spatial scale          | Yield potential of each of the 182 reference weather station buffer-cropping systems were simulated using the most recent weather data, and then were upscaled to larger spatial scales by following Global Yield Gap Atlas protocol. Yield potential and yield gap in 11 country-water regime combinations were estimated at both per rice cycle and per year basis. The current annual domestic rice demand during the period from 2019-2020 was set as a baseline for self-sufficiency ratio and rice surplus estimation. The current and future rice self-sufficiency ratio and surplus were estimated for each of the six countries and the Southeast Asia region as a whole. |
| Data exclusions                   | No data were excluded from the analysis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Reproducibility                   | Data used in this study are available within the paper [and its supplementary information files].                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Randomization                     | Not applicable as we did not conduct field experiments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Blinding                          | Not applicable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Did the study involve field work? | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

## Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

### Materials & experimental systems

| n/a                                 | Involved in the study                                  |
|-------------------------------------|--------------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Antibodies                    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Eukaryotic cell lines         |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Palaeontology and archaeology |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Animals and other organisms   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Human research participants   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Clinical data                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Dual use research of concern  |

### Methods

| n/a                                 | Involved in the study                           |
|-------------------------------------|-------------------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> ChIP-seq               |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> Flow cytometry         |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> MRI-based neuroimaging |