

Reporting Summary

Nature Portfolio 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 Portfolio 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 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 Portfolio [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 description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

To reproduce figures, relevant data and R codes mentioned in the main text could be found in the following repository. Community weighted mean calculated from field raw data are included above. Field measured raw traits data will be open shared through Dryad and TRY trait database after peer-review. Figures, codes and data could be downloaded from

https://github.com/Hzhang-ouce/Ghana_rainfall_trait_variation_optimality_github.

Research involving human participants, their data, or biological material

Policy information about studies with [human participants or human data](#). See also policy information about [sex, gender \(identity/presentation\), and sexual orientation](#) and [race, ethnicity and racism](#).

Reporting on sex and gender	<input type="text" value="Not involving human participants"/>
Reporting on race, ethnicity, or other socially relevant groupings	<input type="text" value="Not involving human participants"/>
Population characteristics	<input type="text" value="Not involving human participants"/>
Recruitment	<input type="text" value="Not involving human participants"/>
Ethics oversight	<input type="text" value="Not involving human participants"/>

Note that full information on the approval of the study protocol must also be provided in the manuscript.

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

Ecological, evolutionary & environmental sciences study design

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

Study description	<input type="text" value="We first summarized the expectations of recent 'universal' theories on how functional traits vary along wet-dry gradients in the tropic, which deduced 15 testable predictions. We focus on functional traits associated with plants' photosynthesis and water transport strategies. Plant functional traits were measured from intact forests/savanna, along a typical VPD gradient in West Africa that has strong variation in VPD and light but not temperatures."/>
Research sample	<input type="text" value="We selected three study areas in Ghana, West Africa. With in these study areas, we set up seven one-hectare forests monitoring plots. They are Ankasa (ANK, two moist rainforest plots), Bobiri (BOB, two semi-deciduous forest plots) and Kogyae (KOG, one dry forests plot and two mesic savanna plots)."/>
Sampling strategy	<input type="text" value="We selected species that contributed to up to 80% of the basal area of each plot and sampled the three largest individuals for each species (see Appendix for exceptions). We then calculate a community weighted mean to represent overall status of the forests stand."/>
Data collection	<input type="text" value="Leaf traits field campaigns were conducted using a standardized protocol between October 2014 and September 2016 in all plots"/>
Timing and spatial scale	<input type="text" value="Between October 2014 and September 2016, some traits are measured seasonally, see appendix for more details."/>
Data exclusions	<input type="text" value="Outliers were checked with the R package outliers::scores, interquartile range method (IQR) with threshold 1.5. Each extreme values are manually inspected. The values are kept when we were sure that they were devoid of error/typo."/>
Reproducibility	<input type="text" value="n/a (this study does not involve experiments, thus no repetition of experiments)"/>
Randomization	<input type="text" value="For most of the traits, we have sampled a large number of leaves, please see figure one for the number of samples."/>
Blinding	<input type="text" value="n/a"/>

Did the study involve field work? Yes No

Field work, collection and transport

Field conditions	<input type="text" value="Variables measuring the environment of the study sites are presented in Figure1 and Table S1."/>
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Location	Ghana, West Africa, see coordinates in Table S1
Access & import/export	When exporting soil samples and leaves samples from Ghana, we applied for permits and adhered to relevant regulations.
Disturbance	Our plant functional traits measurements were made from clipped branches from wild trees.

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	Involvement 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"/> Clinical data
<input checked="" type="checkbox"/>	<input type="checkbox"/> Dual use research of concern
<input type="checkbox"/>	<input checked="" type="checkbox"/> Plants

Methods

n/a	Involvement 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

Plants

Seed stocks	Our plant functional traits measurements were made from clipped branches from wild trees. We did not perform seeds germination.
Novel plant genotypes	N/A
Authentication	N/A