# Online Apppendix for

Two Blades of Grass: The Impact of the Green Revolution

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**FOR ONLINE PUBLICATION ONLY**

# 1 Introduction

This online appendix reports supplementary material to the paper "Two Blades of Grass: The Impact of the Green Revolution" by Douglas Gollin, Casper Worm Hansen, and Asger Moll Wingender.

# 2 Countries in the Sample

Angola, Argentina, Benin, Burkina Faso, Bangladesh, Bolivia, Brazil, Botswana, Central African Republic, Chile, China, Cote d'Ivoire, Cameroon, Congo, Rep., Colombia, Costa Rica, Cuba, Dominican Republic, Algeria, Ecuador, Egypt, Arab Rep., Ethiopia, Gabon, Ghana, Guinea, The Gambia, Guinea-Bissau, Guatemala, Honduras, Haiti, Indonesia, India, Iran, Islamic Rep., Iraq, Jamaica, Kenya, Cambodia, Lao PDR, Lebanon, Liberia, Libya, Sri Lanka, Morocco, Madagascar, Mexico, Mali, Myanmar, Mongolia, Mozambique, Mauritania, Mauritius, Malawi, Malaysia, Namibia, Niger, Nigeria, Nicaragua, Nepal, Pakistan, Panama, Peru, Philippines, Paraguay, Rwanda, Saudi Arabia, Sudan, Senegal, Sierra Leone, El Salvador, Swaziland, Syrian Arab Republic, Chad, Togo, Thailand, Tunisia, Turkey, Tanzania, Uganda, Uruguay, Venezuela, Vietnam, Yemen, Rep., South Africa, Zambia, and Zimbabwe.

# 3 Attainable Yields Maps

Figures 1A–8A depict maps showing the spatial variation in attainable yields (under the high-input level and irrigation assumptions) for the eight crops that were not shown in the paper in order to save space. The crops are: barley, cassava, dry beans, groundnut, millet, potato, rice, and maize.

*[Figures 1A–8A about here]*

# 4 Additional Robustness Tests

## 4.1 Start and Ending Year

This section reports the baseline 2SLS results when starting the analysis in 1940, which, due to missing data, give rise to an unbalanced panel and when stopping the analysis in 1990, implying that these estimates would mostly capture variation in the first diffusion wave of HYV crops. As seen from Table 1A, we obtain similar 2SLS estimates, both in the extended sample (columns 1 and 3) and reduced sample (columns 2 and 4).

*[Table 1a about here]*

## 4.2 Initial Economic Characteristics

Table 2a controls for initial log GDP per capita, initial population density, initial institutions,[1] initial trade share, initial urbanization interacted with a full set of year fixed effects. Besides for initial institution, initial refers to the year 1960. This type of check takes into account the possibility that, for example, initial income could be correlated with our measure for the potential for growing HYVs and we, therefore, with our baseline estimate unintentionally captures possible convergence in income over the considered period. However, as seen from the 2SLS estimates, reported Table 2a, our findings for income and population are robust, both in magnitude and statistical significance, to this type of possible initial heterogeneity.

*[Table 2a about here]*

## 4.3 Time-Varying Temperatures and Precipitation

In the paper, we show that the baseline estimates for income and population are robust to controlling for average temperature and precipitation interacted with a full set year fixed effects.[2] Table 3a reports the estimates from our baseline specification which has been augmented with

[1] As measured by the average constraint on the executive (from the Polity IV dataset) in 1950, 1960, and 1970.

[2] The averages are calculated on the basis of temperature on precipitation level during the second half of the 20th century.

time-varying temperatures and precipitation. These data, which are obtained from Dell et al. (2012), are available at the country-by-year level, and they are, therefore, collapsed to country-by-decade level, taking the average annual temperature/precipitation over the preceding decade in order to fit into our empirical framework. We see that controlling for these two variables does little to our baseline estimates; if anything, the effect of HYV adoption on income and population increases in magnitude.

*[Table 3a about here]*

## 4.4 Country-Specific Linear Time Trends

Table 4a adds country specific linear time trends to our baseline specification, which implies, since the outcomes are in logs, that the model can now be interpreted in terms of growth rates. This also means that we include one additional pre-treatment year (i.e., 1950).[3] Table 4a shows that while the estimate for income increases in magnitude, it looses some precision and is now only borderline statistically significant. The estimated coefficient for population remains stable both in magnitude and significance.

*[Table 4a about here]*

## 4.5 Crop-Specific Effects

While our baseline specification in the paper pools all 10 HYVs into one HYVs adoption variable, Table 5a investigates possible crop-specific effects. In particular, we construct HYV-adoption variables for wheat, rice, and the remaining eight crops but otherwise following the baseline 2SLS strategy. We find that the effects on income of HYV adoption in wheat and rice are positive, statistically significant, and of the same magnitude, while the negative effects on population size seem to be primarily (statistically) related to the adoption of HYV in rice. We note that the estimated coefficients for the all-other HYV crops are larger in numerically magnitude, however, in terms of standardized beta coefficients, the (pooled) effects of the remaining crops are substantially smaller.

[3] In order to add these types of parametric country trends, at the least two pre-treatment years are necessary.

# References

[1] Dell, M., B. F. Jones, and B. A. Olken, 2012. Temperature Shocks and Economic Growth: Evidence from the Last Half Century. American Economic Journal: Macroeconomics, 4(3), 66–95.

## Table 1a: Robustness to start and ending year

| | First and last year in sample: | | | |
|---|---|---|---|---|
| | 1940 & 2000 | 1960 & 1990 | 1940 & 2000 | 1960 & 1990 |
| | (1) | (2) | (3) | (4) |
| | Dependent variable (in logs): | | | |
| | *GDP/capita* | | *Population* | |
| *Actual HYV adoption* | 1.394*** | 1.251** | -0.629*** | -0.506** |
| | (0.438) | (0.584) | (0.209) | (0.206) |
| Observations | 534 | 336 | 536 | 336 |
| Countries | 84 | 84 | 84 | 84 |
| Estimator | 2SLS | 2SLS | 2SLS | 2SLS |
| Kleibergen-Paap | 20.18 | 14.58 | 20.14 | 14.58 |

Notes: The table reports 2SLS estimates based on estimation equations (1) and (4) in the paper. The observations are reported at the country level every decade over the period 1960–2000. All regressions include country and time fixed effects. The dependent variables are in logs and indicated at the top column. The main explanatory variable are: Actual HYV adoption, which is the actual share planted with HYV crops and Predicted HYV adoption, which is the predicted share of HYV crops according to equation (3) in the paper. Standard errors (in parentheses) account for arbitrary heteroskedasticity and are clustered at the country level. *** p<0.01, ** p<0.05, * p<0.1.

Table 2a: Robustness to initial economic characteristics

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Dependent variable (in logs): | | | | | | | | | |
| | *GDP/capita* | | | | | *Population* | | | | |
| *Actual HYV adoption* | 1.741*** | 1.406*** | 1.590*** | 1.556*** | 1.633*** | -0.477*** | -0.459** | -0.526*** | -0.492*** | -0.324** |
| | (0.419) | (0.455) | (0.364) | (0.388) | (0.436) | (0.170) | (0.221) | (0.160) | (0.166) | (0.159) |
| **Controls** ($\times \sum$) | | | | | | | | | | |
| Log GDP/capita$_{1960}$ | Yes | No | No | No | No | Yes | No | No | No | No |
| Log Pop. density$_{1960}$ | No | Yes | No | No | No | No | Yes | No | No | No |
| Instituions | No | No | Yes | No | No | No | No | Yes | No | No |
| Trade share$_{1960}$ | No | No | No | Yes | No | No | No | No | Yes | No |
| Urbanization rate$_{1960}$ | No | No | No | No | Yes | No | No | No | No | Yes |
| Observations | 420 | 420 | 365 | 375 | 420 | 420 | 420 | 365 | 375 | 420 |
| Countries | 84 | 84 | 73 | 75 | 84 | 84 | 84 | 73 | 75 | 84 |
| Estimator | 2SLS | 2SLS | 2SLS | 2SLS | 2SLS | 2SLS | 2SLS | 2SLS | 2SLS | 2SLS |
| Kleibergen-Paap | 23.10 | 23.46 | 21.50 | 25.64 | 18.64 | 23.10 | 23.46 | 21.50 | 25.64 | 18.64 |

Notes: The table reports 2SLS estimates based on estimation equations (1) and (4) in the paper. The observations are reported at the country level every decade over the period 1960–2000. All regressions include country and time fixed effects. The dependent variables are in logs and indicated at the top column. The main explanatory variable are: Actual HYV adoption, which is the actual share planted with HYV crops and Predicted HYV adoption, which is the predicted share of HYV crops according to equation (3) in the paper. Standard errors (in parentheses) account for arbitrary heteroskedasticity and are clustered at the country level.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3a: Robustness to time varying temperature and precipitation

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Dependent variable (in logs): | | | | | |
| | *GDP/capita* | | | *Population* | | |
| *Actual HYV adoption* | 1.574*** | 1.853*** | 1.918*** | -0.562*** | -0.493*** | -0.482*** |
| | (0.414) | (0.446) | (0.444) | (0.189) | (0.174) | (0.178) |
| *Temperature* | 0.136* | | 0.163* | 0.0134 | | 0.0280 |
| | (0.0815) | | (0.0853) | (0.0295) | | (0.0269) |
| *Precipitation* | | 0.00731 | 0.0115 | | 0.0168*** | 0.0175*** |
| | | (0.0120) | (0.0119) | | (0.00572) | (0.00569) |
| Observations | 410 | 410 | 410 | 410 | 410 | 410 |
| Countries | 83 | 83 | 83 | 83 | 83 | 83 |
| Estimator | 2SLS | 2SLS | 2SLS | 2SLS | 2SLS | 2SLS |
| Kleibergen-Paap | 24.16 | 22.37 | 21.64 | 24.16 | 22.37 | 21.64 |

Notes: The table reports 2SLS estimates based on estimation equations (1) and (4) in the paper. The observations are reported at the country level every decade over the period 1960–2000. All regressions include country and time fixed effects. The dependent variables are in logs and indicated at the top column. The main explanatory variable are: Actual HYV adoption, which is the actual share planted with HYV crops and Predicted HYV adoption, which is the predicted share of HYV crops according to equation (3) in the paper. Standard errors (in parentheses) account for arbitrary heteroskedasticity and are clustered at the country level.

*** p<0.01, ** p<0.05, * p<0.1.

Table 4a:
Robustness to linear time trends

| | (1) | (3) |
|---|---|---|
| | Dependent variable (in logs): | |
| | *GDP/ capita* | *Population* |
| *Actual HYV adoption* | 1.718 | -0.669** |
| | (1.234) | (0.273) |
| Linear time trends | Yes | Yes |
| Observations | 420 | 420 |
| Countries | 84 | 84 |
| Estimator | 2SLS | 2SLS |
| Kleibergen-Paap | 14.61 | 14.61 |

Notes: The table reports 2SLS estimates based on estimation equations (1) and (4) in the paper. The observations are reported at the country level every decade over the period 1960–2000. All regressions include country, time fixed effects and country specific linear time trends. The dependent variables are in logs and indicated at the top column. The main explanatory variable are: Actual HYV adoption, which is the actual share planted with HYV crops and Predicted HYV adoption, which is the predicted share of HYV crops according to equation (3) in the paper. Standard errors (in parentheses) account for arbitrary heteroskedasticity and are clustered at the country level.
*** p<0.01, ** p<0.05, * p<0.1.

Table 5a: Crop-specific effects

| | (1) | (2) | (4) | (5) |
|---|---|---|---|---|
| | Dependent variable (in logs): | | | |
| | *GDP/capita* | | *Population* | |
| *Wheat HYV adoption* | 1.144*** | 1.713*** | -0.226 | -0.375 |
| | (0.372) | (0.536) | (0.182) | (0.228) |
| *Rice HYV adoption* | 0.978** | 1.483*** | -0.452*** | -0.584*** |
| | (0.429) | (0.482) | (0.130) | (0.191) |
| *Other HYVs adoption* | | 4.474* | | -1.171 |
| | | (2.513) | | (0.828) |
| Observations | 420 | 420 | 420 | 420 |
| Countries | 84 | 84 | 84 | 84 |
| Estimator | 2SLS | 2SLS | 2SLS | 2SLS |
| F-stat. wheat | 25.92 | 19.94 | 25.92 | 19.94 |
| F-stat. rice | 16.67 | 11.32 | 16.67 | 11.32 |
| F-stat. other | - | 3.81 | - | 3.81 |

Notes: The table reports 2SLS estimates based on estimation equations (1) and (4) in the paper. The observations are reported at the country level every decade over the period 1960–2000. All regressions include country and time fixed effects. The dependent variables are in logs and indicated at the top column. The main explanatory variable are: wheat HYV adoption, rice HYV adoption, and the remaining eight HYV crops. These adoption rates are instrumented with the predicted share of HYV of wheat, HYV of rice, and HYVs of the remaining crops, respectively. Standard errors (in parentheses) account for arbitrary heteroskedasticity and are clustered at the country level.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

**Figure 1A:** Agro-climatically attainable yields, Barley

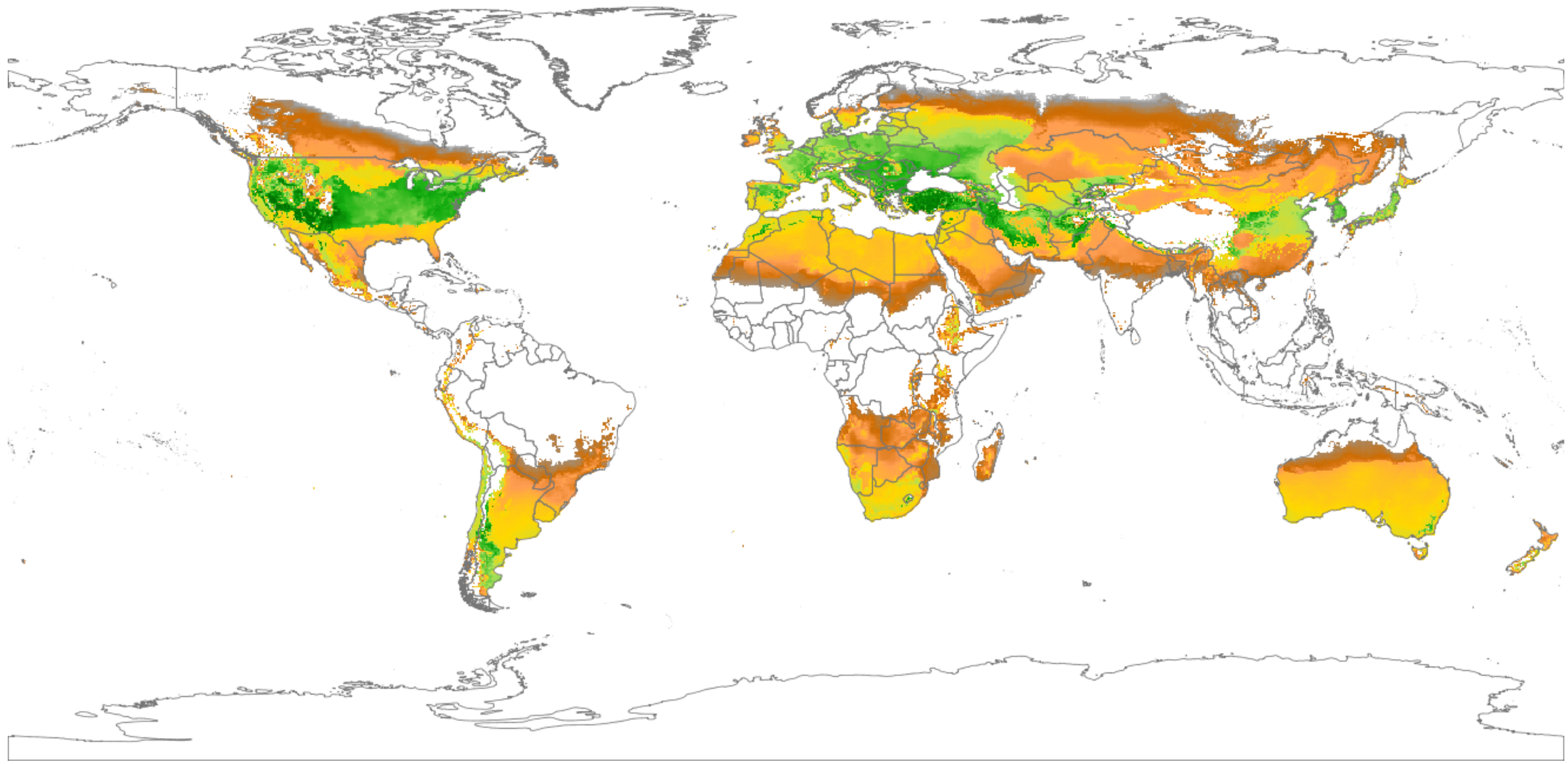


**Figure 2A:** Agro-climatically attainable yields, Cassava

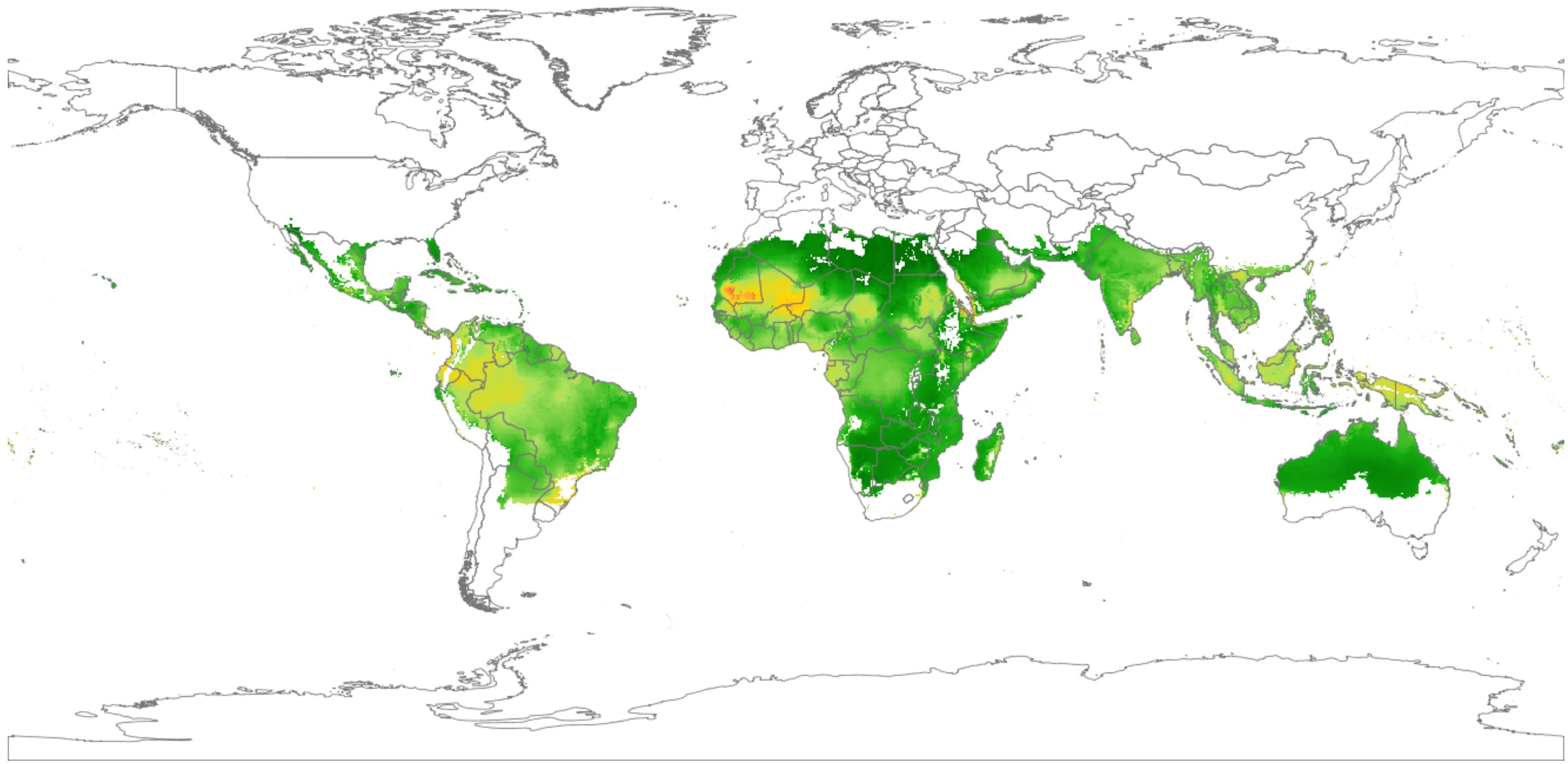


**Figure 3A:** Agro-climatically attainable yields, Dry beans

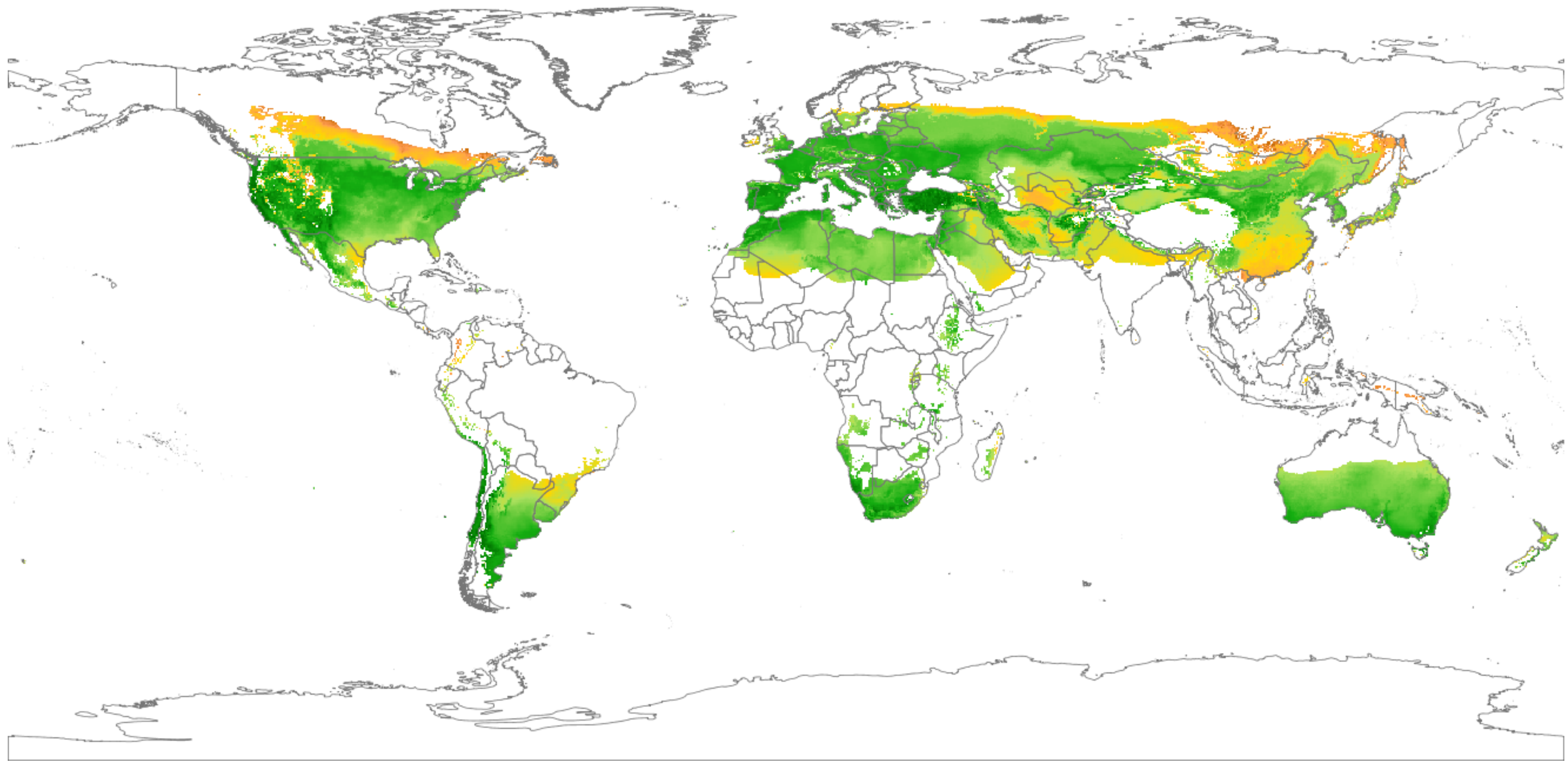


**Figure 4A:** Agro-climatically attainable yields, Groundnut

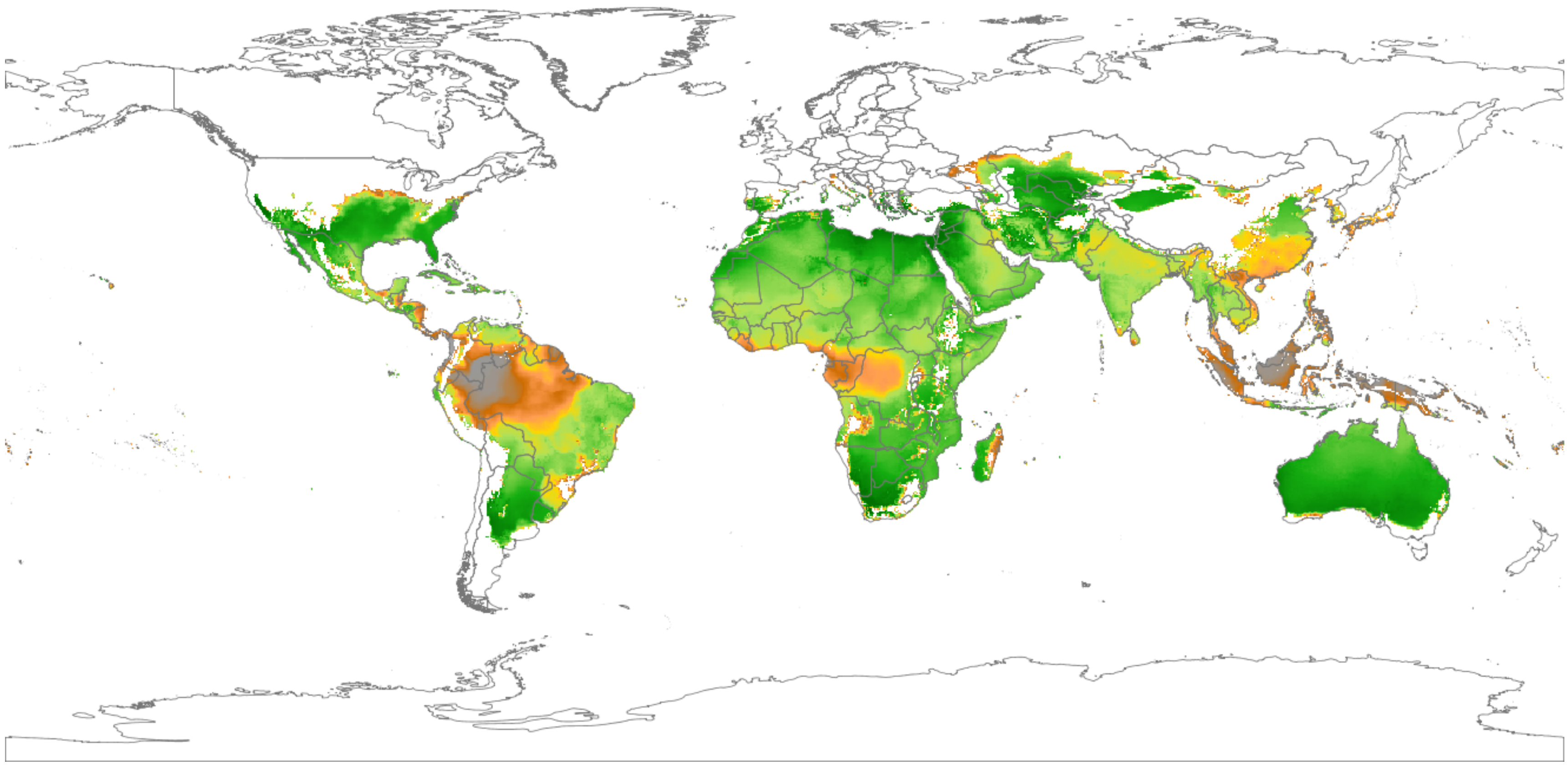
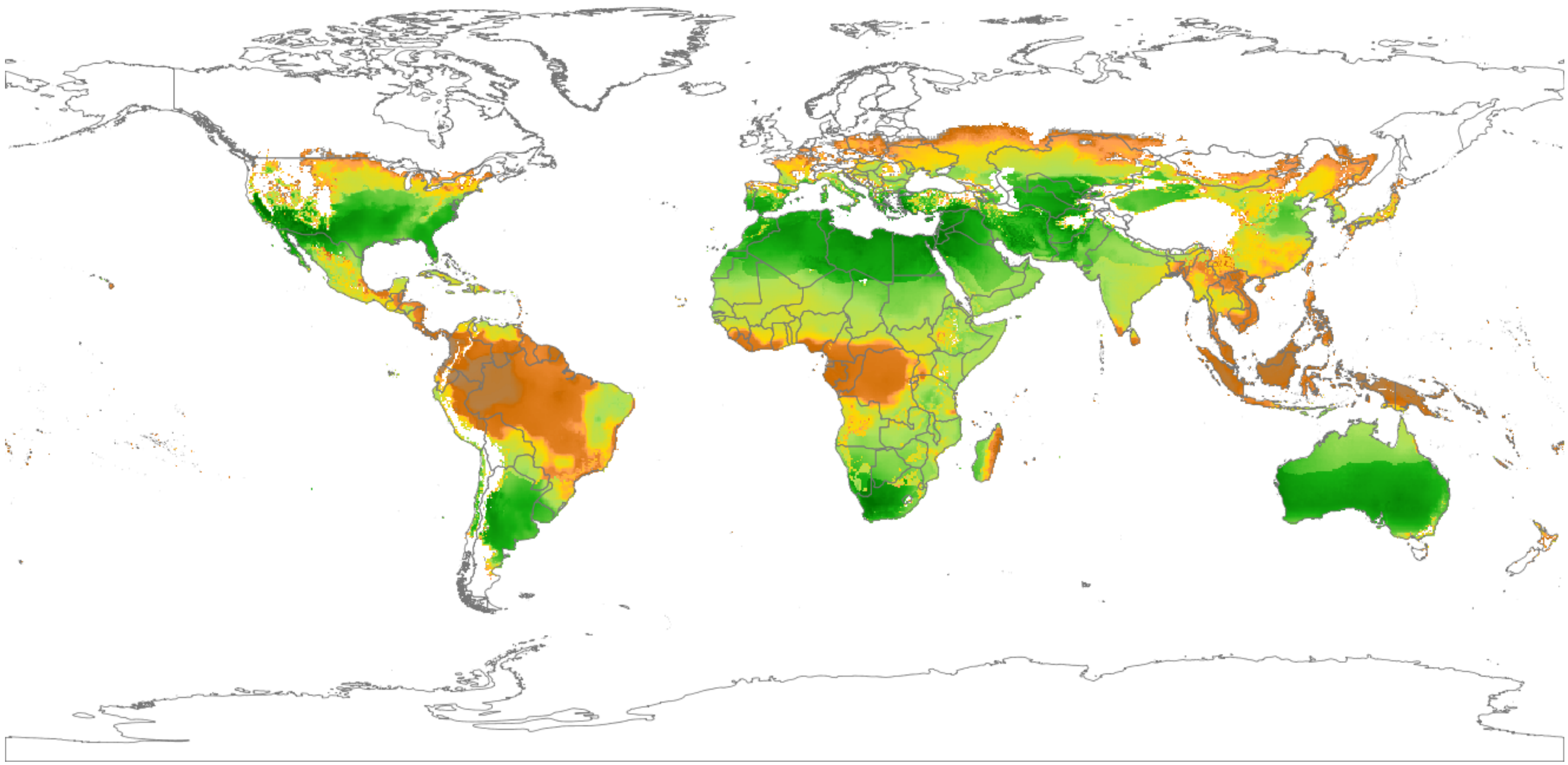


**Figure 5A:** Agro-climatically attainable yields, Maize



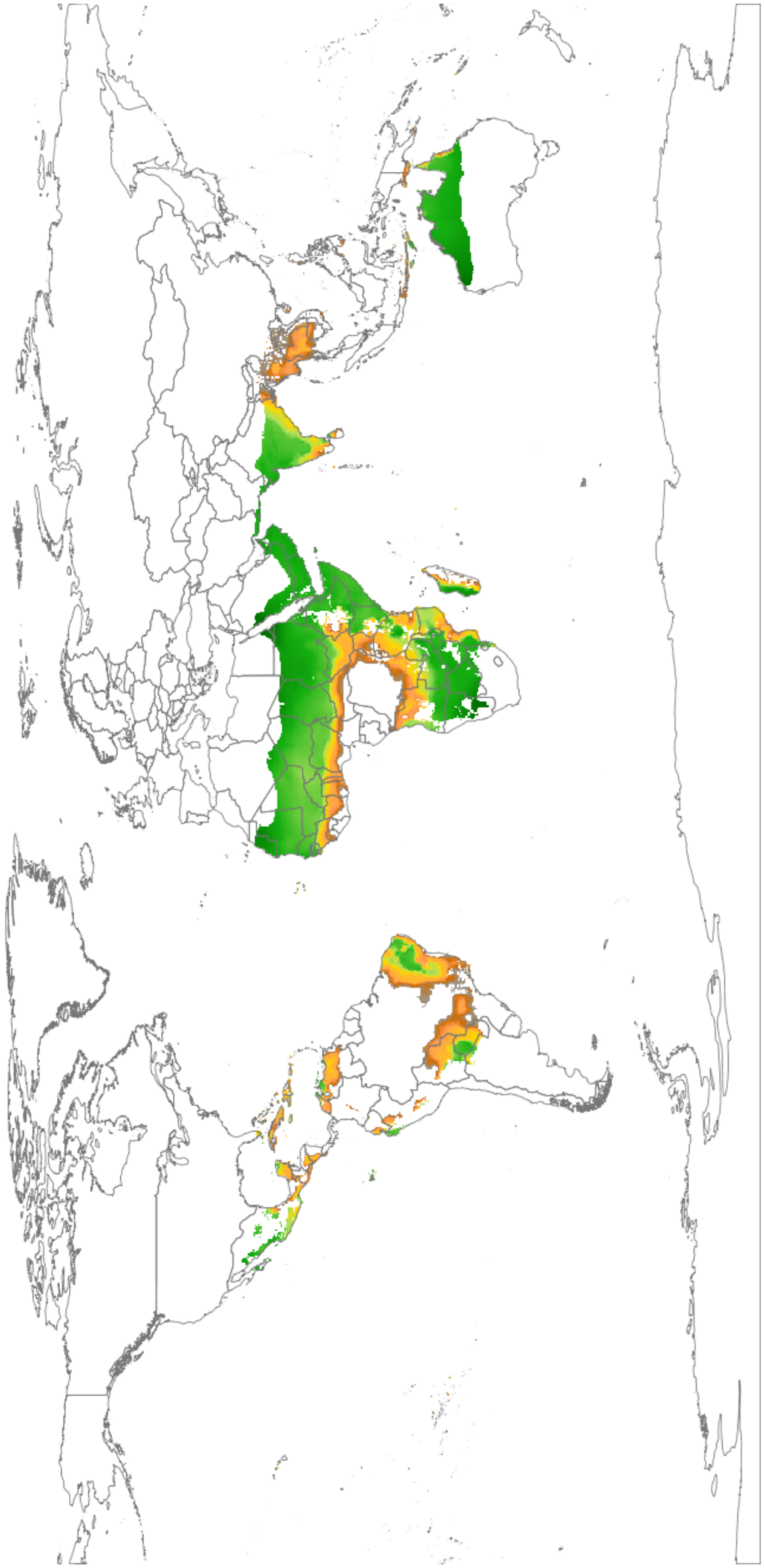


**Figure 6A:** Agro-climatically attainable yields, Millet

**Figure 7A:** Agro-climatically attainable yields, Potato

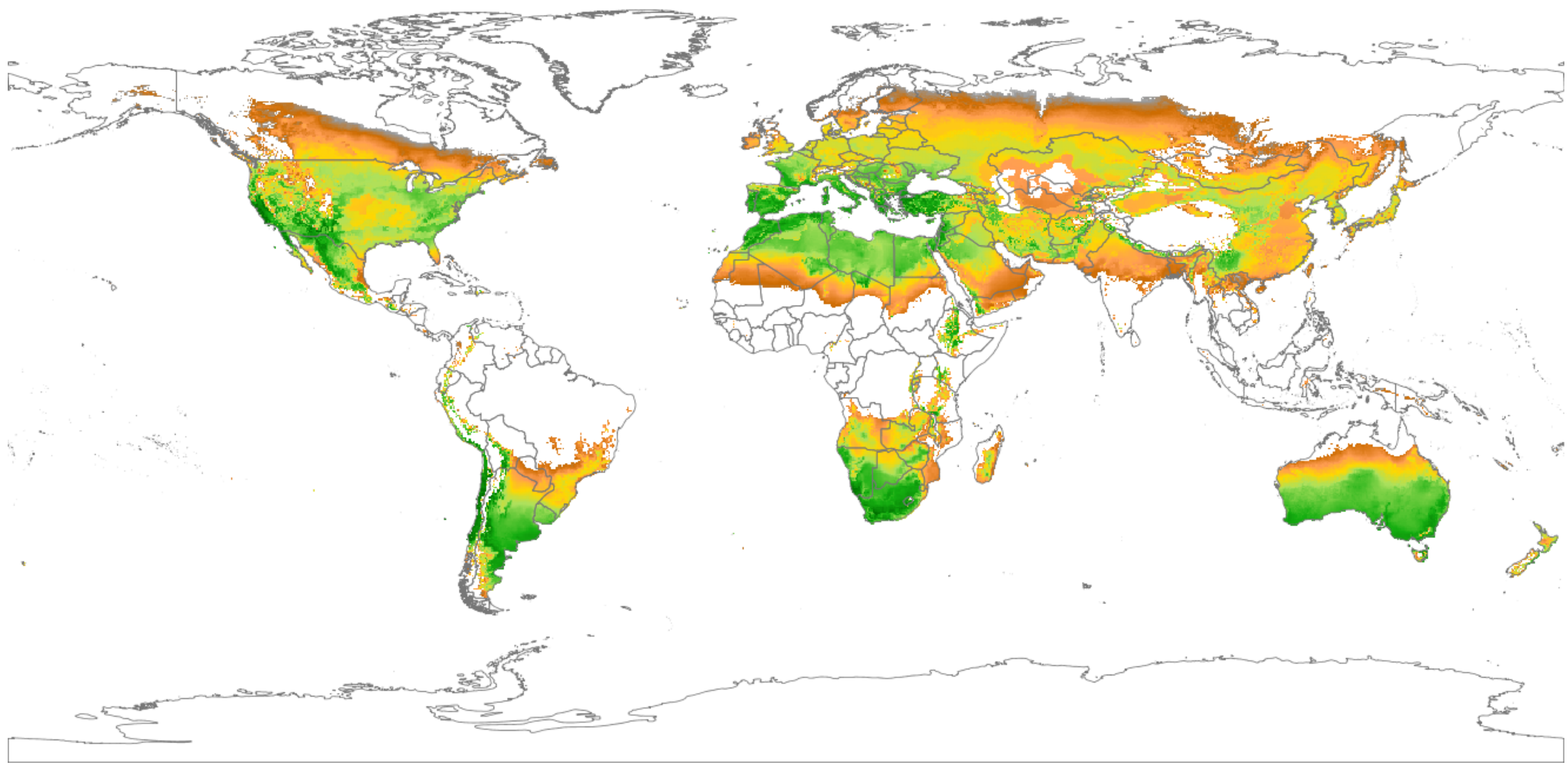


**Figure 8A:** Agro-climatically attainable yields, Rice