Poverty, rural population distribution and climate change

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ONLINE APPENDIX

Appendix A. Supplementary statistical tables

Table A1. Descriptive statistics for key household survey and rural population distribution variables, by country

Country	Region	Survey year T	Survey year t	Average monthly ($) per capita income or consumption expenditure year t	Headcount poverty rate ($2 per day) year t	Gini Index year t	Share (%) of rural population on less favored agricultural land (2000)	Share (%) of rural population in less favored agricultural areas (2000)	Share (%) of rural population located on remote less favored agricultural land (2000)	Share (%) of rural population on less favored agricultural land located on remote less favored agricultural land (2000)
Albania	Europe and Central Asia	2008	2002	135.86	8.86	28.15	76.90	76.90	12.43	16.16
Angola	Sub-Saharan Africa	2008	2000	62.92	70.30	58.64	16.94	17.93	10.47	61.83
Armenia	Europe and Central Asia	2010	2001	78.00	50.93	36.22	52.77	52.77	14.11	26.73
Azerbaijan	Europe and Central Asia	2008	2001	112.27	27.28	36.50	34.06	36.86	8.65	25.40
Bangladesh	South Asia	2010	2000	43.27	84.50	33.46	9.42	12.96	0.73	7.75
Belarus	Europe and Central Asia	2011	2000	206.42	1.91	30.35	26.33	27.24	0.73	2.79
Bhutan	South Asia	2012	2003	2003	49.66	46.83	22.63	23.86	17.50	77.32
Bolivia	Latin America and the Caribbean	2008	2000	176.32	37.91	62.78	6.24	7.78	4.95	79.40
Bosnia and Herzegovina	Europe and Central Asia	2007	2001	352.46	0.29	28.03	91.66	91.76	16.43	17.92
Brazil	Latin America and the Caribbean	2009	2001	289.22	21.73	60.13	49.65	50.06	3.31	6.67
Bulgaria	Europe and Central Asia	2007	2001	206.97	7.83	34.34	84.40	84.44	5.85	6.93
Burkina Faso	Sub-Saharan Africa	2009	2003	46.85	81.32	39.60	26.43	34.50	7.32	27.69
Burundi	Sub-Saharan Africa	2006	1998	24.32	95.44	42.39	76.11	76.80	10.94	14.37
Cambodia	East Asia and Pacific	2009	2004	67.06	41.85	41.85	53.02	57.40	6.05	11.41
Cameroon	Sub-Saharan Africa	2009	2001	111.50	32.61	40.41	27.07	27.78	6.39	23.60
Central African Republic	Sub-Saharan Africa	2008	2003	41.78	81.99	43.57	3.10	3.70	1.79	57.87
China	East Asia and Pacific	2009	2002	84.09	51.29	42.59	46.69	48.85	12.42	26.61
Colombia	Latin America and the Caribbean	2010	2000	172.64	31.83	58.68	29.17	29.71	6.99	23.96
Costa Rica	Latin America and the Caribbean	2009	2000	275.90	10.90	46.53	18.92	19.74	8.05	42.54
Cote d'Ivoire	Sub-Saharan Africa	2008	2002	101.11	46.93	48.39	45.89	50.19	10.50	22.88
Dominican Republic	Latin America and the Caribbean	2010	2000	298.24	10.99	52.01	10.22	10.23	2.42	23.71
Ecuador	Latin America and the Caribbean	2010	2000	146.89	37.73	56.59	24.47	27.24	5.94	24.28
Egypt, Arab Rep.	Middle East and North Africa	2008	2004	112.51	18.64	32.76	1.70	1.89	0.02	1.33
El Salvador	Latin America and the Caribbean	2009	2001	214.56	23.04	53.60	53.74	53.74	0.71	1.32
Ethiopia	Sub-Saharan Africa	2010	2005	51.40	77.79	29.83	37.06	37.96	20.82	56.18
Fiji	East Asia and Pacific	2008	2002	90.97	48.78	46.81				
Gambia, The	Sub-Saharan Africa	2003	1998	42.08	81.30	50.23	29.88	53.07	9.35	31.30
Georgia	Europe and Central Asia	2010	2000	97.48	41.09	41.09	41.49	42.34	9.75	23.51
Ghana	Sub-Saharan Africa	2005	1998	62.66	63.48	40.75	41.07	45.75	4.78	11.64
Guatemala	Latin America and the Caribbean	2006	2000	186.11	39.24	54.28	39.40	40.32	5.23	13.27
Guinea	Sub-Saharan Africa	2007	2003	46.37	80.90	40.30	44.49	46.85	11.30	25.40
Honduras	Latin America and the Caribbean	2009	2001	171.57	31.14	54.38	39.93	40.10	3.85	9.64
Hungary	Europe and Central Asia	2007	2000	285.92	0.39	27.32	39.57	39.73	0.82	2.07
India	South Asia	2009	2004	53.49	75.77	33.38	27.70	29.51	3.88	14.02

Indonesia	East Asia and Pacific	2010	2002	60.79	67.16	29.74	51.46	52.11	11.92	23.16
Iran, Islamic Rep.	Middle East and North Africa	2005	1998	251.94	8.37	44.10	18.94	18.99	4.74	25.04
Jamaica	Latin America and the Caribbean	2004	2002	280.63	8.57	48.34	5.68	5.68	0.27	4.72
Jordan	Middle East and North Africa	2010	2002	175.55	2.15	38.87	32.75	33.01	0.15	0.47
Kazakhstan	Europe and Central Asia	2009	2001	117.10	30.42	41.11	54.67	55.97	22.73	41.58
Kenya	Sub-Saharan Africa	2005	1997	97.41	42.85	42.51	38.82	41.93	9.09	23.43
Kyrgyz Republic	Europe and Central Asia	2011	2002	57.83	66.83	31.67	41.47	41.79	14.32	34.53
Lao PDR	East Asia and Pacific	2008	2002	51.08	77.00	32.63	21.81	22.37	5.24	24.02
Macedonia, FYR	Europe and Central Asia	2008	2000	169.87	11.57	34.44	85.87	85.87	11.28	13.14
Madagascar	Sub-Saharan Africa	2010	2001	31.63	88.81	47.47	19.96	21.14	4.07	20.39
Malawi	Sub-Saharan Africa	2010	2004	34.12	90.51	39.02	30.54	31.71	6.52	21.36
Malaysia	East Asia and Pacific	2009	2004	204.31	7.88	37.91	50.88	52.27	14.72	28.94
Maldives	South Asia	2004	1998	204.98	37.11	62.69				
Mali	Sub-Saharan Africa	2010	2001	41.60	82.14	40.01	29.52	32.76	8.28	28.04
Mauritania	Sub-Saharan Africa	2008	2000	88.33	44.29	39.04	1.33	1.33	0.33	24.49
Mexico	Latin America and the Caribbean	2010	2000	247.55	15.18	51.87	17.72	18.07	2.97	16.76
Moldova	Europe and Central Asia	2010	2001	74.83	54.50	38.59	87.06	87.14	1.25	1.44
Morocco	Middle East and North Africa	2007	2000	133.66	24.47	40.63	42.63	42.99	5.81	13.62
Mozambique	Sub-Saharan Africa	2007	2002	36.58	90.09	47.11	30.85	41.86	10.28	33.32
Nepal	South Asia	2010	2003	53.96	77.41	43.83	39.03	41.69	14.69	37.65
Nicaragua	Latin America and the Caribbean	2005	2001	114.34	34.52	43.06	52.69	53.61	4.49	8.52
Niger	Sub-Saharan Africa	2007	2005	41.46	85.66	43.89	6.48	7.59	1.27	19.56
Nigeria	Sub-Saharan Africa	2011	2003	40.52	83.17	42.93	21.93	24.22	2.32	10.60
Pakistan	South Asia	2007	2001	54.66	74.09	30.39	12.08	14.05	3.61	29.87
Panama	Latin America and the Caribbean	2010	2001	257.69	23.70	57.30	25.99	27.01	7.12	27.41
Paraguay	Latin America and the Caribbean	2010	2001	190.50	24.17	50.75	31.22	32.86	10.85	34.74
Peru	Latin America and the Caribbean	2010	2000	190.50	24.17	50.75	17.26	17.32	7.98	46.21
Philippines	East Asia and Pacific	2009	2000	103.16	44.97	46.09	63.46	64.19	19.23	30.31
Romania	Europe and Central Asia	2011	2000	117.94	17.37	30.25	60.19	60.24	3.36	5.58
Rwanda	Sub-Saharan Africa	2010	2000	38.64	89.12	51.51	73.41	73.23	14.78	20.18
Senegal	Sub-Saharan Africa	2011	2001	58.55	71.43	41.25	39.01	41.05	4.14	10.60
Serbia	Europe and Central Asia	2010	2002	337.83	0.61	32.74				
Sierra Leone	Sub-Saharan Africa	2011	2003	51.20	76.19	42.52	41.61	43.24	4.28	10.28
South Africa	Sub-Saharan Africa	2008	2000	153.14	43.00	57.77	49.21	49.36	15.71	31.93
Sri Lanka	South Asia	2009	2002	100.06	39.92	41.06	52.54	56.46	8.81	16.76
Swaziland	Sub-Saharan Africa	2009	2000	47.15	81.10	50.68	60.56	60.74	19.79	32.68
Tajikistan	Europe and Central Asia	2009	2003	56.71	68.22	32.62	46.63	47.08	11.71	25.12
Tanzania	Sub-Saharan Africa	2007	2000	25.44	95.28	34.62	36.51	44.41	12.59	34.48
Thailand	East Asia and Pacific	2010	2000	157.63	18.15	42.84	40.56	43.13	9.96	24.56
Timor-Leste	East Asia and Pacific	2007	2001	49.18	77.60	39.52	64.80	66.01	64.68	99.81
Togo	Sub-Saharan Africa	2011	2006	56.21	69.48	34.41	26.80	35.60	7.28	27.17
Tunisia	Middle East and North Africa	2010	2000	182.41	12.91	40.81	42.10	42.11	4.27	10.15
Turkey	Europe and Central Asia	2010	2002	212.07	9.65	42.71	67.27	67.32	7.66	11.38
Uganda	Sub-Saharan Africa	2009	2002	50.20	79.96	45.77	37.92	38.41	5.39	14.23
Ukraine	Europe and Central Asia	2010	2002	170.09	3.45	28.28	53.30	53.54	1.46	2.74
Venezuela, RB	Latin America and the Caribbean	2006	2001	178.70	20.80	47.23	30.04	31.05	7.97	26.53
Vietnam	East Asia and Pacific	2008	2002	59.72	68.86	37.55	30.79	32.82	3.37	10.94
Yemen, Rep.	Middle East and North Africa	2005	1998	90.34	36.52	33.44	4.36	4.36	2.81	64.43
Zambia	Sub-Saharan Africa	2010	2002	41.07	85.23	42.08	33.89	43.34	19.91	58.75
	Number			83	83	83	80	80	80	80

Mean	145.70	46.41	42.40	38.15	40.04	8.50	24.74
Median	100.06	42.85	41.85	38.37	41.37	7.06	23.55
Minimum	24.32	0.29	27.32	1.33	1.33	0.02	0.47
Maximum	2003.00	95.44	62.78	91.66	91.76	64.68	99.81
Standard Deviation	222.44	29.56	8.76	20.95	20.79	8.40	18.81

Source: Household survey variables are from PovcalNet, the on-line tool for poverty measurement developed by the Development Research Group of the World Bank (available online at http://iresearch.worldbank.org/PovcalNet/). Rural population distribution variables are based on authors' estimates; see "Technical notes, data sources and mapping methods" in online appendix B below.

Table A2. Key estimated parameters and statistical tests for s_1 and s_2 variables

A. Share (%) of rural population on less favored agricultural land (2000), s_1

	OLS		3SLS			
			β_1		δ_1	
	α_1	β_1	With controls	Without controls	With controls	Without controls
Parameter estimates	0.007	-3.413	-2.147	-2.359	0.608	0.594
	(0.497)	(-3.223)**	(-3.846)**	(-3.755)**	(8.996)**	(6.192)**
Observations (N)	80		80	80	80	80
R^2	0.36		0.57	0.46	0.69	0.32
Likelihood ratio test	36.10**		74.54**	50.67**	96.85**	33.35**
F-test	14.45**		19.96**	65.28**	55.42**	37.39**
Homogeneity test	24.50**					

B. Share (%) of rural population in less favored agricultural areas (2000), s_2

	OLS		3SLS			
			β_1		δ_1	
	α_1	β_1	With controls	Without controls	With controls	Without controls
Parameter estimates	0.005	-2.816	-2.146	-2.393	0.650	0.666
	(0.361)	(-2.560)**	(-3.846)**	(-3.994)**	(9.174)**	(6.632)**
Observations (N)	80		80	80	80	80
R^2	0.33		0.57	0.46	0.69	0.35
Likelihood ratio test	31.73**		74.54**	51.00**	98.97**	37.08**
F-test	12.33**		19.92**	65.87**	57.60**	42.89**
Homogeneity test	19.18**					

Notes:
OLS is ordinary least squares; 3SLS is three-stage least squares. t-ratios are in parentheses. **significant at the 1% level. The homogeneity test is the t-test for the restriction $\beta_0 + \beta_1 = 0$ in equation (4) of the main text.
The first two columns report the results for the estimated parameters α_1 and β_1, and the relevant test statistics for the OLS estimations of (4). The IV elasticity estimates were generally not significant, and so are not indicated in the table. In all estimations, the null hypothesis $\alpha_1 = 0$ cannot be rejected, which indicates that the spatial distribution variables do not influence directly changes in poverty. Although the homogeneity test suggests that this restriction can be rejected, further estimations and tests of estimations of (4) without the s_k variables and imposing homogeneity indicate that this restriction should apply.

The final four columns report the results for the 3SLS estimated parameters β_1 and δ_1 corresponding to equations (4a) and (4b) in the main text. These parameters are used in the analysis of how these spatial variables affect the poverty-reducing impact of growth in income per capita reported in table 5 in the main text.

Table A3. Key estimated parameters and statistical tests for s_3 and s_4 variables

A. Share (%) of rural population located on remote less favored agricultural land (2000), s_3

	OLS		**3SLS**			
			β_1		δ_1	
	α_1	β_1	With controls	Without controls	With controls	Without controls
Parameter estimates	0.009	-0.256	-2.351	-2.923	0.526	0.572
	(0.879)	(-0.063)	(-4.778)**	(-6.346)**	(12.300)**	(10.496)**
Observations (N)	80		80	80	80	80
R^2	0.27		0.57	0.48	0.78	0.58
Likelihood ratio test	25.27**		74.36**	53.85**	126.40**	71.30**
F-test	9.41**		19.88**	71.08**	91.52**	107.42**
Homogeneity test	0.23					

B. Share (%) of rural population on less favored agricultural land located on remote land (2000), s_4

	OLS		**3SLS**			
			β_1		δ_1	
	α_1	β_1	With controls	Without controls	With controls	Without controls
Parameter estimates	0.010	3.12	-2.370	-3.046	0.634	0.688
	(0.723)	(1.450)	(-4.812)**	(-6.866)**	(12.512)**	(11.531)**
Observations (N)	80		80	80	80	80
R^2	0.33		0.57	0.48	0.79	0.62
Likelihood ratio test	32.02**		74.33**	53.87**	128.20**	80.35**
F-test	12.47**		19.87**	71.12**	94.17**	129.64**
Homogeneity test	0.29					

Notes:
OLS is ordinary least squares; 3SLS is three-stage least squares. t-ratios are in parentheses. **significant at the 1% level. The homogeneity test is the t-test for the restriction $\beta_0 + \beta_1 = 0$in equation (4) of the main text.
The first two columns report the results for the estimated parameters α_1 and β_1, and the relevant test statistics for the OLS estimations of (4). The IV elasticity estimates were generally not significant, and so are not indicated in the table. In all estimations, the null hypothesis $\alpha_1 = 0$ cannot be rejected, which indicates that the spatial distribution variables do not influence directly changes in poverty. In addition, the homogeneity test for these spatial distribution variables suggests that this restriction cannot be rejected.

The final four columns report the results for the 3SLS estimated parameters β_1 and δ_1 corresponding to equations (4a) and (4b) in the main text. These parameters are used in the analysis of how these spatial variables affect the poverty-reducing impact of growth in income per capita reported in table 5 in the main text.

Appendix B. Technical notes, data sources and mapping methods

Data sources:

Several geospatial datasets were utilized in this analysis

(1) National boundaries were determined from the Gridded Population of the World, Version 3 (GPWv3): National Administrative Boundaries file as published by the Center for International Earth Science Information Network (CIESIN) and Centro Internacional de Agricultura Tropical (CIAT) in 2005. Country boundaries are denoted by polygons and are identified using unique ISO3V10 3-letter country/state codes. The geographic coordinates of this dataset are in decimal degrees using the World Geodetic System spheroid of 1984 (WGS84). Territories of countries were not included in this analysis.

Center for International Earth Science Information Network (CIESIN), Columbia University; and Centro Internacional de Agricultura Tropical (CIAT). 2005. Gridded Population of the World Version 3 (GPWv3): National Boundaries. Palisades, NY: Socioeconomic Data and Applications Center (SEDAC), Columbia University. [Available at] http://sedac.ciesin.columbia.edu/gpw

(2) Populations for 2000 and 2010 were identified using the Gridded Population of the World, Version 3 (GPWv3) dataset published in 2005 by the CIESIN, International Food Policy Research Institute (IFPRI) and CIAT. It was chosen not to use the higher resolution Global Rural-Urban Mapping Project (GRUMP), Version 1 also published by CIESIN because in addition to 1990, 1995 and 2000 population data, the GPWv3 also offers population projections for 2005, 2010 and 2015. The resolution of this GRID formatted raster is 0.041666667 by 0.041666667 decimal degrees or 2.5 by 2.5 arc-minutes (approximately 5 km^2 cells).

Center for International Earth Science Information Network (CIESIN)/Columbia University, United Nations Food and Agriculture Programme (FAO), and Centro Internacional de Agricultura Tropical (CIAT). 2005. Gridded Population of the World, Version 3 (GPWv3): Population Count Grid. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). [Available at] http://sedac.ciesin.columbia.edu/data/set/gpw-v3-population-count

(3) Urban areas were identified using the Urban Extents Grid, Version 1 (1995) from GRUMP V1. This data was published in 2011 by CIESIN, International Food Policy Research Institute (IFPRI), the World Bank and Centro Internacional de Agricultura Tropical (CIAT). The resolution of this GRID formatted raster is 0.0083333333 by 0.0083333333 decimal degrees or 30 arc-seconds (approximately 1 km^2 cells). Rural areas were defined as those that are non-urban.

Center for International Earth Science Information Network (CIESIN)/Columbia University, International Food Policy Research Institute (IFPRI), The World Bank, and Centro Internacional de Agricultura Tropical (CIAT). 2011. Global Rural-Urban Mapping Project, Version 1 (GRUMPv1): Urban Extents Grid. Palisades, NY: NASA Socioeconomic Data and

Applications Center (SEDAC).[Available at] http://sedac.ciesin.columbia.edu/data/set/grump-v1-urban-extents

(4) Length of growing period (LGP) data, using a baseline period of 1961-1990, was published by the FAO on the Global Agro-Ecological Zones (GAEZ) Data Portal on 2012-05-02 in the Agro-climatic resources series with the "Growing period" collective title. The resolution of this TIFF formatted raster is 0.083333333 by 0.083333333 decimal degrees or 5 by 5 arc-minutes (approximately 10 km^2 cells).

FAO Global Agro-Ecological Zones Data Portal version 3. [Available at] http://gaez.fao.org/

(5) Terrain data, for median terrain slope classes, was published by the FAO on the Global Agro-Ecological Zones (GAEZ) Data Portal on 2012-05-02 in the land resources series with the "Terrain Resources" collective title. The dataset's eight relevant terrain classes include (i) 0 - 0.5 per cent, (ii) 0.5 - 2 per cent, (iii) 2 – 5 per cent, (iv) 5 – 8 per cent, (v) 8 – 16 per cent, (vi) 16 – 30 per cent, (vii) 30 – 45 per cent and (viii) >45 per cent. The resolution of this TIFF formatted raster is 0.083333333 by 0.083333333 decimal degrees or 5 by 5 arc-minutes (approximately 10 km^2 cells).

FAO Global Agro-Ecological Zones Data Portal version 3. [Available at] http://gaez.fao.org/

(6) Soil constraints are identified from a series of data sources published by the FAO on the Global Agro-Ecological Zones (GAEZ) Data Portal on 2012-05-02 in the land resources series with the "Soil Resources" collective title. There are seven constraints on soil including (i) nutrient availability, (ii) nutrient retention capacity, (iii) rooting conditions, (iv) oxygen availability to roots, (v) excess salts, (vi) toxicity, and (vii) workability. Within each soil constraint category there are four levels classifying how constrained soil is including (i) No or slight constraints, (ii) Moderate constraints, (iii) Severe constraints and (iv) Very severe constraints. We consider less favoured soil where any of these constraints are considered severe or very severe. The resolution of this TIFF formatted raster is 0.083333333 by 0.083333333 decimal degrees or 5 by 5 arc-minutes (approximately 10 km^2 cells).

FAO Global Agro-Ecological Zones Data Portal version 3. [Available at] http://gaez.fao.org/ *(*

(7) Irrigated cultivated land data was published by the FAO on the Global Agro-Ecological Zones (GAEZ) Data Portal on 2012-05-02 in the land resources series with the "Water Resources" collective title. The percentage of land equipped for irrigation is given for each pixel in the dataset. Consistent with the Fan and Hazell (1999), we classify land as irrigated if greater than 25 per cent of all cultivated land within a pixel is irrigated. The resolution of this TIFF formatted raster is 0.083333333 by 0.083333333 decimal degrees or 5 by 5 arc-minutes (approximately 10 km^2 cells).

Fan, S., and P. Hazell. 1999. "Are Returns to Public Investment Lower in Less-Favoured Rural Areas? An Empirical Analysis of India". Environment and Production Technology Division Discussion Paper 43. International Food Policy Research Institute, Washington, DC.

FAO Global Agro-Ecological Zones Data Portal version 3. [Available at] http://gaez.fao.org/

(8) Market accessibility was used to identify remote areas using Nelson (2008) *"Travel time to major cities: A global map of accessibility"* as released by the Global Environment Monitoring Unit of the Joint Research Centre of the European Commission. Market access is identified as less than five hours of travel to a market city with a population of 50,000 or more. This dataset was published in seconds of travel to the nearest city and was converted to hours of travel. Additional details on how travel distances and speeds were calculated and accompanying assumptions can be found at http://bioval.jrc.ec.europa.eu/products/gam/description.htm. The resolution of this GRID formatted raster is 0.0083333333 by 0.0083333333 decimal degrees or 30 arc-seconds (approximately 1 km^2 cells).

Nelson, A. 2008. Travel time to major cities: A global map of Accessibility. Global Environment Monitoring Unit - Joint Research Centre of the European Commission, Ispra Italy. [Available at] http://gem.jrc.ec.europa.eu/

(9) Global agricultural lands were identified using the International Food Policy Research Institute's (IFPRI) Pilot Analysis of Global Ecosystem (PAGE) agricultural extent (PAGE v.1).

Pilot Analysis of Global Ecosystems (PAGE): Agroecosystems, 2000. 2005. Washington, DC: World Resources Institute and the International Food Policy Research Institute.(datasets)[Available at] http://www.ifpri.org/dataset/pilot-analysis-global-ecosystems-page

Consistent with the original seasonal land cover region (SLCR) agriculture threshold (see You et al. (2008) for greater detail), we set the percent of land cover area consisting of "cropland, grazing land or irrigated area net of areas with a growing period of zero days" (Sebastian 2006) threshold at thirty percent.

You, Liangzhi, Stanley Wood, and Kate Sebastian. 2008 "Comparing And Synthesizing Different Global Agricultural Land Datasets For Crop Allocation Modeling." The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 37(B7), 1433-40.

Sebastian, K. 2006b. Global Extent of Agriculture. Dataset derived from Ramankutty (2005 & 2002), Siebert (2006) and IIASA/FAO (2000). International Food Policy Research Institute (IFPRI).Washington, D.C. Unpublished data

Note the thirty percent threshold is slightly more restrictive than the ten percent threshold used in the World Development Report (WDR) 2008 analysis (Sebastian 2007), which will make our estimates of individuals on agricultural land conservative.

Sebastian, K. 2007. GIS/Spatial Analysis Contribution to 2008 WDR. [Available at] http://siteresources.worldbank.org/INTWDR2008/Resources/2795087-1191427986785/SebastianK_ch2_GIS_input_report.pdf

The source data for the agricultural extent is the 1992-93 Advanced High Resolution Radiometer (AVHRR) dataset, which was used to calculate individuals on agricultural land in the year 2000. Calculations of individuals on agricultural land for 2010 were scaled linearly by the change in agricultural land percentage from 2000 to 2010, respectively. Agricultural land (per cent of land area) data for 2000 and 2010 is from the World Bank's World Development Indicators (WDI). Regional classifications (both *developing* and *all countries*) and income classifications were also extracted from the most recent version of the WDI. Developing economies are those that were low, lower-middle or upper-middle income as of *18 December 2013.*

World Development Indicators, 1960-2013. The World Bank. Last updated 18-Dec-2013. [Available at] http://data.worldbank.org/data-catalog/world-development-indicators

Raster dataset management: [1]

All of the raster datasets used in these analyses were resampled to 30 arc-second ERDAS IMAGINE (.img) formatted raster layers using the nearest neighbor resampling technique. Raster alignment was ensured by setting the geoprocessing environment to snap all raster datasets to the extent of the LGP dataset (Top 90, Left -180, Right 180, Bottom -90). The population raster datasets from the GPWv3 were resampled (and values converted appropriately) from 2.5 arc-minute resolution to 30 arc-second resolution.

Less favoured land:

Length of growing period data was reclassified for cells with a LGP from 0 – 119 (Arid and Semi-Arid) having an assigned value of "1" and all other cells having an assigned value of "NoData". Terrain was reclassified for cells with a median slope of 0 per cent - 8 per cent having a value of "NoData" and cells with a slope >8 per cent having a value of "1". The classes that corresponded to steep terrain included class 5 (8 per cent – 16 per cent), class 6 (16 per cent - 30 per cent), class 7 (30 per cent - 45 per cent) and class 8 (>45 per cent).

Irrigated land with poor soil and irrigated land with steep terrains were calculated with a cell value of "1" to create the product of each individual constraint (e.g. Irrigated*Poor Soil, Irrigated*Steep Terrain) for less favoured land and "NoData" for those areas not affected by these constraints.

Rainfed land with LGP>120 days on >8 per cent sloped land and rainfed land with LGP>120 days on poor soil quality land were also calculated for the product of each of the constraint. Rainfed land was defined as land that was not irrigated (land with per pixel irrigated cell area coverage of 25 per cent or less).

[1] All geospatial analysis was conducted using ESRI ArcGIS 10.1 licensed to the University of Wyoming.

The four raster constraints on less favoured land, (i) irrigated land on > 8 per cent slope, (ii) rainfed land with LGP>120 days on >8 per cent slope (iii) rainfed land with LGP>120 days and poor soil and (iv) arid (LGP<60 days) and semi-arid (LGP 60-119 days) lands, were combined into a single less favoured land mosaic. This less favoured land mosaic was masked to include only agricultural land creating a mosaic of less favoured agricultural land (LFAL).

All population summations, within the boundaries of countries, were conducted within the extent of the urban-rural raster dataset. Population counts of interest were then calculated using zonal statistics and a mask on rural areas, at the country level, to create our key variables of interest.

Less favoured areas:

An accessibility mask was created from the market accessibility dataset by reclassifying raster values as "1" if the cell was 5 hour more hours from the nearest market center of 50,000 or more individuals. This mask resembles remote areas. The favoured land dataset, defined as those areas that are not less favoured, was extracted to include only remote favoured locations. The "rural less favoured land" raster dataset and the "remote favoured land" raster datasets were combined into a single mosaic representing less favoured areas. Variables of interest were calculated using zonal statistics as the country level.

Remote agricultural and less favoured agricultural land:

Additional refinements (extracting populations from the LFAL and LFAA datasets using the remoteness mask and summarizing those populations) were made to create our remaining indicators.

Degrading and improving lands and areas:

Two decades of land degradation and improvement data are analysed (1981-2000), using the difference in the annual sum NPP between 2000 and 1981. Degrading land is defined as land with a negative NPP change over these twenty years. Improving land is defined as land that is not degrading (land with a non-negative change in NPP). These degrading and improving lands are dissected in a manner analogous to the divisions in the LFAL and LFAA analyses. Rural individuals on degrading and improving agricultural land were separately summarized using the improving and degrading land masks, respectively. These individuals were then masked, using the remoteness indicator, and summarized to find the rural population located on all remote degrading (and improving) agricultural land.

Maps

All accompanying maps (see figures A1-A4) are projected using a standard Robinson (world) projection.

Definitions

Less Favoured Agricultural Land (LFAL): *Less favoured agricultural land (LFAL) consists of irrigated land on terrain greater than 8 per cent median slope; rainfed land with a length of growing period (LGP) of more than 120 days but either on terrain greater than 8 per cent*

median slope or with poor soil quality; semi-arid land (land with LGP 60-119 days); and arid land (land with LGP < 60 days).

Less Favoured Agricultural Areas (LFAA): *Less favoured agricultural areas (LFAA) include less favoured agricultural land as well as favoured agricultural land with limited market access (i.e. located in remote areas). Market access is identified as less than five hours of travel to a market city with a population of 50,000 or more.*

Length of Growing Period (LGP): Length of growing period (LGP) data, using a baseline period of 1961-1990, was published by the FAO on the Global Agro-Ecological Zones (GAEZ) Data Portal on 2012-05-02 in the Agro-climatic resources series with the "Growing period" collective title.

Terrain: Terrain data, for median terrain slope classes, was published by the FAO on the Global Agro-Ecological Zones (GAEZ) Data Portal on 2012-05-02 in the land resources series with the "Terrain Resources" collective title. The dataset's eight relevant terrain classes include (i) 0 - 0.5 per cent, (ii) 0.5 - 2 per cent, (iii) 2 – 5 per cent, (iv) 5 – 8 per cent, (v) 8 – 16 per cent, (vi) 16 – 30 per cent, (vii) 30 – 45 per cent and (viii) >45 per cent.

Soil Constraints: Soil constraints are identified from a series of data sources published by the FAO on the Global Agro-Ecological Zones (GAEZ) Data Portal on 2012-05-02. There are seven constraints on soil including (i) nutrient availability, (ii) nutrient retention capacity, (iii) rooting conditions, (iv) oxygen availability to roots, (v) excess salts, (vi) toxicity, and (vii) workability. Within each soil constraint category there are four levels classifying how constrained soil is including (i) No or slight constraints, (ii) Moderate constraints, (iii) Severe constraints and (iv) Very severe constraints. We consider less favoured soil where any of these constraints are considered severe or very severe.

Irrigated areas: Irrigated cultivated land data was published by the FAO on the Global Agro-Ecological Zones (GAEZ) Data Portal on 2012-05-02 in the land resources series with the "Water Resources" collective title. The percentage of land equipped for irrigation is given for each pixel in the dataset. Consistent with the Fan and Hazell (1999), we classify land as irrigated if greater than 25 per cent of all cultivated land within a pixel is irrigated.

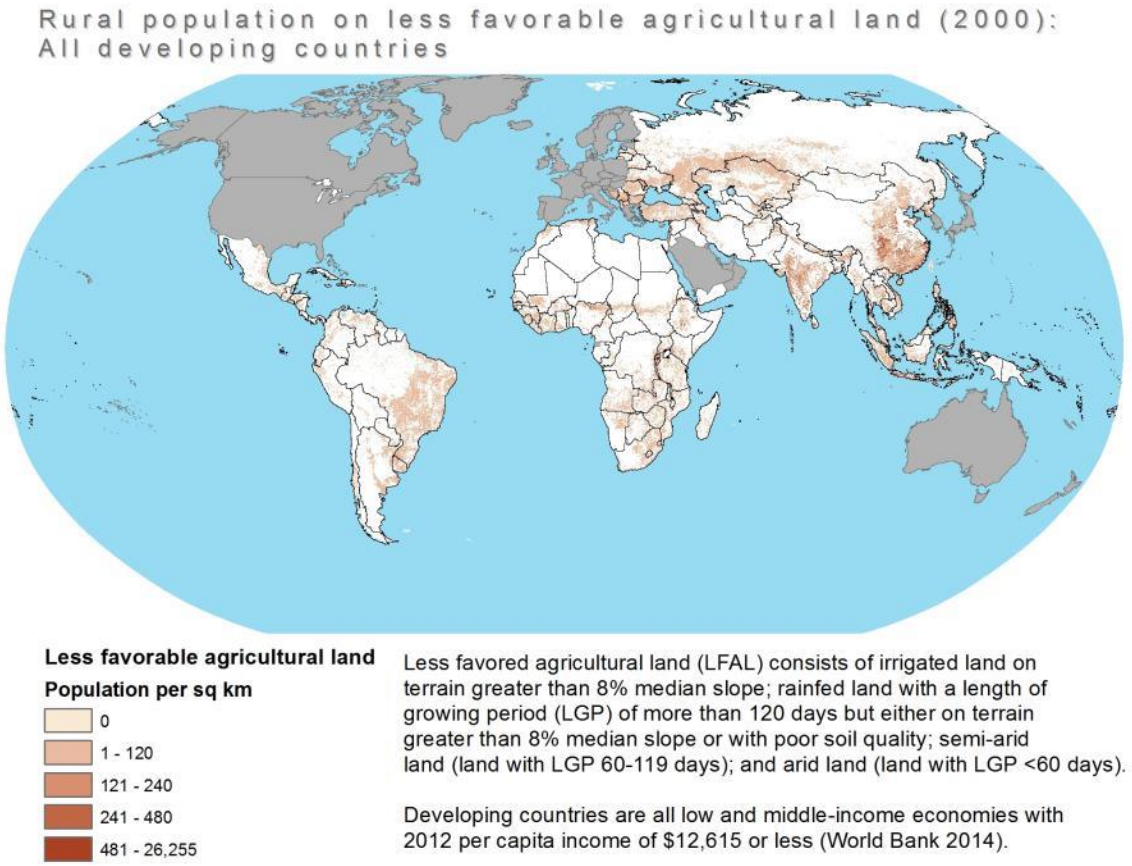

Figure A1. Distribution of rural population of developing countries on less favoured agricultural land, 2000

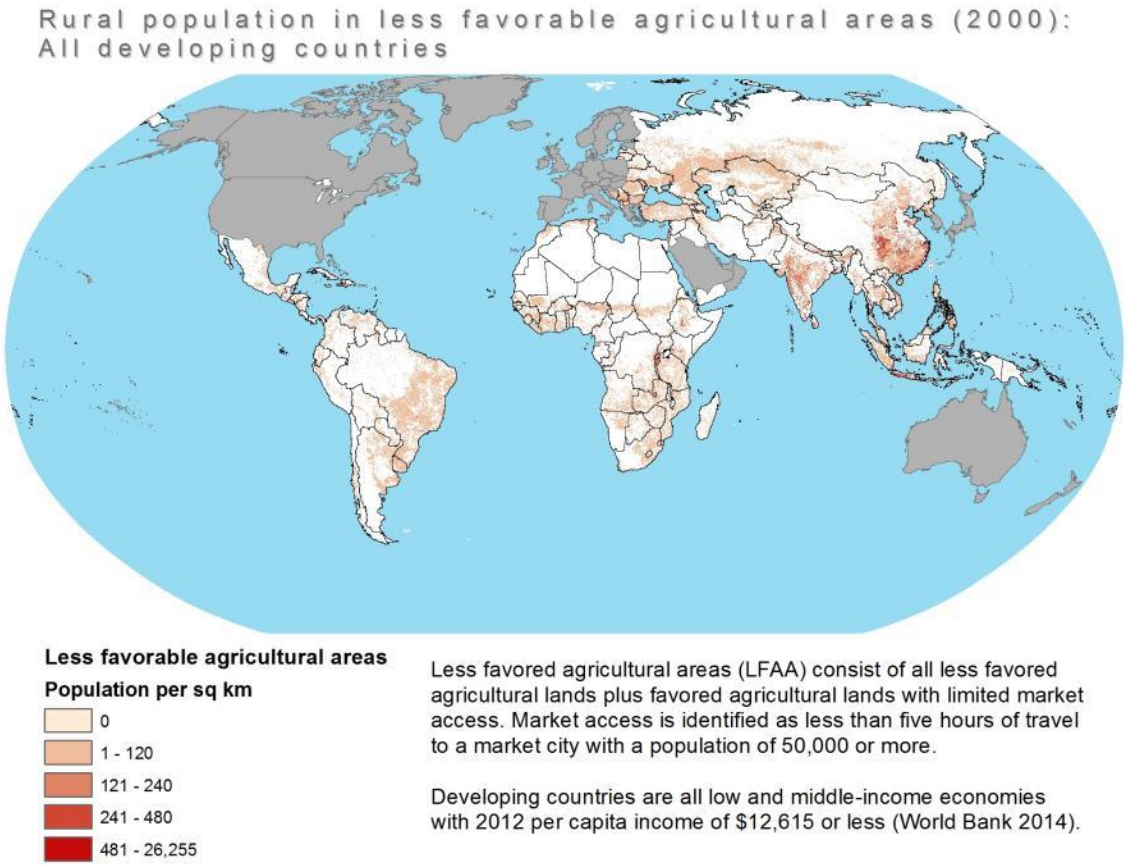

Figure A2. Distribution of rural population of developing countries in less favoured agricultural areas, 2000

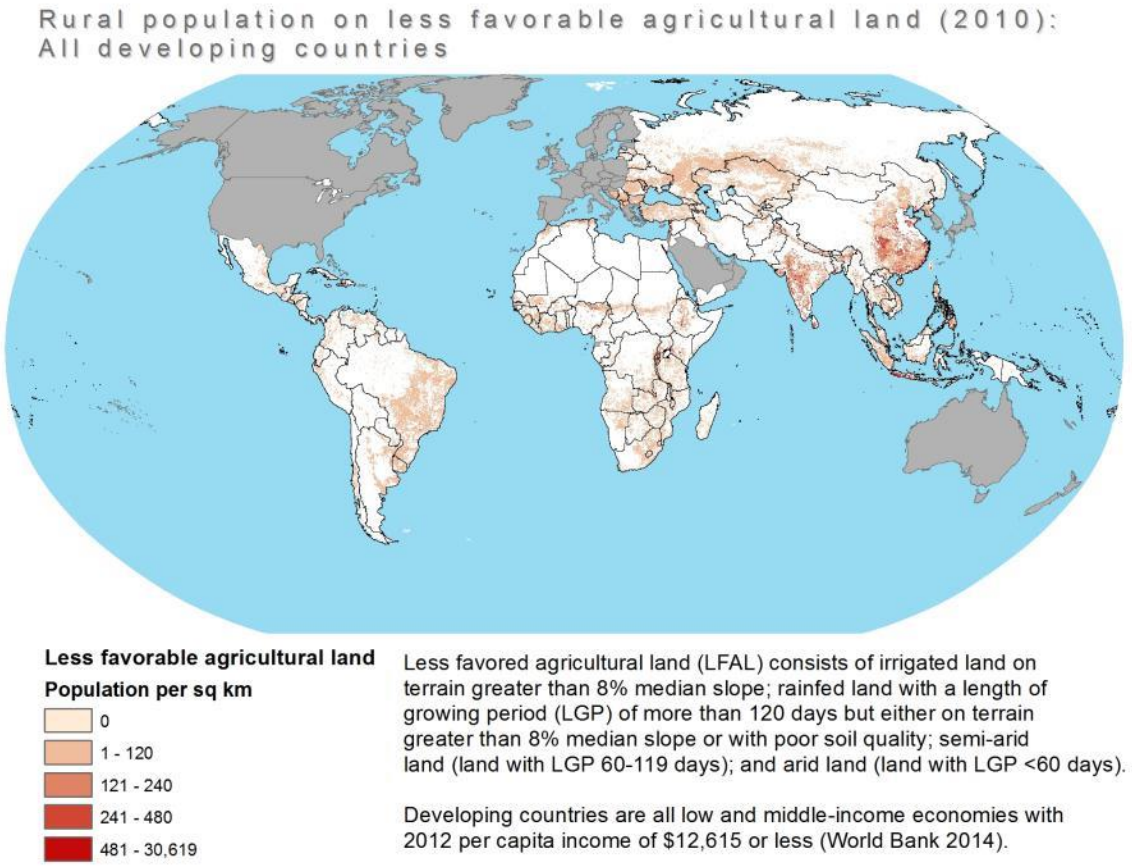

Figure A3. Distribution of rural population of developing countries on less favoured agricultural land, 2010

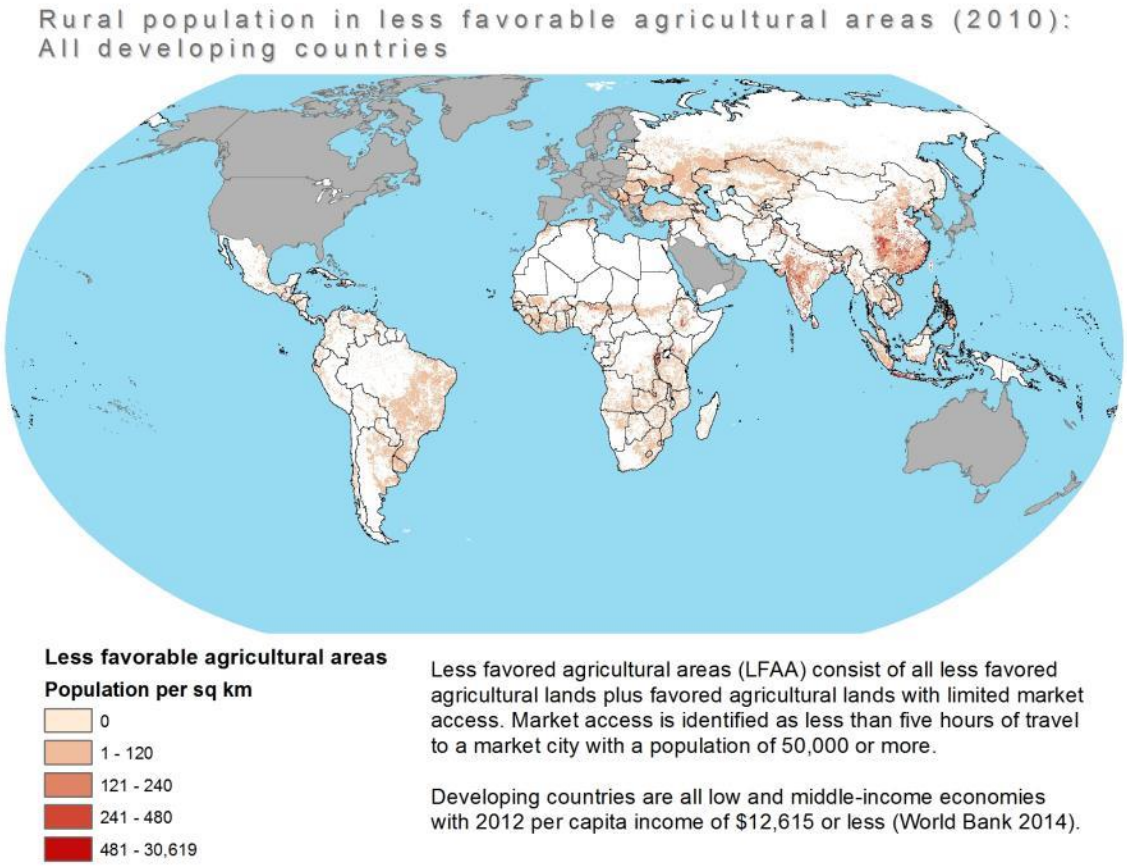

Figure A4. Distribution of rural population of developing countries in less favoured agricultural areas, 2010