

Endnotes

Climate Risks in Africa

- 1 Dilley, M. et al. 2021. "Present and Projected Climate Risks in Africa." In *State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World*, 68–99. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- 2 IPCC. 2021. *Climate Change 2021: The Physical Science Basis*. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Edited by V. Masson-Delmotte et al. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg1/>. The Sixth Assessment Report (AR6) relies on Phase 6 of the Coupled Model Intercomparison Projects (CMIP6). For an overview, see: Eyring, V. et al. 2016. "Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) Experimental Design and Organization." *Geoscientific Model Development* 9 (5): 1937–58. doi:10.5194/gmd-9-1937-2016. For a simplified explanation for lay readers, see: Hausfather, Z. 2019. "CMIP6: The next Generation of Climate Models Explained." *Carbon Brief*, December 2. <https://www.carbonbrief.org/cmip6-the-next-generation-of-climate-models-explained/>.
- 3 Dilley et al., 2021, "Present and Projected Climate Risks in Africa."
- 4 WMO. 2022. *The State of the Global Climate 2021*. Geneva: World Meteorological Organization. https://library.wmo.int/index.php?lvl=notice_display&id=22080.
- 5 WMO. 2022. *United in Science 2022. A Multi-Organization High-Level Compilation of the Most Recent Science Related to Climate Change, Impacts and Responses*. Geneva: World Meteorological Organization. https://public.wmo.int/en/resources/united_in_science.
- 6 See <https://www.emdat.be>.
- 7 Trisos, C.H. et al. 2022. "Africa." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by H.-O. Pörtner et al., 1285–1455. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>. See also: IPCC. 2022. "Fact Sheet – Africa." Synthesis of the findings of Working Group II in the Sixth Assessment Report. Geneva: Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar6/wg2/downloads/outreach/IPCC_AR6_WGII_FactSheet_Africa.pdf.
- 8 See <https://www.emdat.be>.
- 9 IFRC. 2021. "Come Heat or High Water: Tackling the Humanitarian Impacts of the Climate Crisis Together." *World Disasters Report 2020*. Geneva: International Federation of Red Cross and Red Crescent Societies. <https://www.ifrc.org/document/world-disasters-report-2020>.
- 10 WMO, 2022, *The State of the Global Climate 2021; 2022, United in Science 2022*.
- 11 WMO, 2022, *The State of the Global Climate 2021*.
- 12 See <https://thinkhazard.org/en/>.
- 13 Borries, R. von, D. Campbell-Lendrum, and R. Stefanski. 2021. "Heatwaves, Wildfires and Air Pollution: Compounding and Cascading Climate Hazards to Health." In *United in Science 2021. A Multi-Organization High-Level Compilation of the Most Recent Science Related to Climate Change, Impacts and Responses*. Geneva: World Meteorological Organization. https://library.wmo.int/doc_num.php?explnum_id=10794.
- 14 Pozzer, A. et al. 2020. "Regional and Global Contributions of Air Pollution to Risk of Death from COVID-19." *Cardiovascular Research* 116 (14): 2247–53. doi:10.1093/cvr/cvaa288. The estimates were derived from epidemiological data for North America and Asia. For Africa, the authors estimated that air pollution contributed to about 7 percent of COVID-19 deaths.
- 15 See Section 9.5.9 in Trisos et al., 2022, "Africa."
- 16 WMO, 2022, *The State of the Global Climate 2021*.
- 17 See Section 9.5.9 in Trisos et al., 2022, "Africa." The IPCC found no clear indication, however, that climate change would affect the frequencies of ENSO and IOD overall.
- 18 See Section 9.5 in Trisos et al., 2022, "Africa."
- 19 Mbow, C. et al. 2021. "Climate, Land, Agriculture and Biodiversity (CLAB-AFRICA): An African Initiative to Support Climate and Biodiversity Global Negotiations." Pretoria: Future Africa Institute. https://www.futureafrica.science/hub/clab/CLAB%20Report_1%20November%202021.pdf.
- 20 See the IPCC "Frequently Asked Questions" section on climate-resilient development, a central theme of the Sixth Assessment Report: <https://www.ipcc.ch/report/ar6/wg2/about/frequently-asked-questions/keyfaq6/>.
- 21 Trisos et al., 2022, "Africa."
- 22 Paterson, L. et al. 2022. "Early Warning Systems: Supporting Adaptation and Disaster Risk Reduction." In *United in Science 2022. A Multi-Organization High-Level Compilation of the Most Recent Science Related to Climate Change, Impacts and Responses*. Geneva: World Meteorological Organization. https://public.wmo.int/en/resources/united_in_science.
- 23 Trisos et al., 2022, "Africa."
- 24 See Section 9.4.3 in Trisos et al., 2022, "Africa."
- 25 Trisos, C.H. et al. 2022. "The IPCC's Sixth Assessment Report: Impacts, Adaptation Options and Investment Areas for a Climate-Resilient Southern Africa." Climate and Development Knowledge Network, African Climate and Development Initiative, SouthSouthNorth and ODI. <https://cdkn.org/resource/ipcc-sixth-assessment-report-new-factsheet-decision-makers-southern-africa>.
- 26 See Section 9.11 in Trisos et al., 2022, "Africa."
- 27 See Section 9.8.2 in Trisos et al., 2022, "Africa."
- 28 Richardson, K. et al. 2022. "Climate Risk Report for the East Africa Region." London: UK Met Office, ODI, and Foreign, Commonwealth & Development Office. <https://www.gov.uk/research-for-development-outputs/climate-risk-report-for-the-east-africa-region>.
- 29 See Sections 9.8.2 and 9.8.3 in Trisos et al., 2022, "Africa." See also Richardson et al., 2022, "Climate Risk Report for the East Africa Region."
- 30 See Section 9.8.2.2 in Trisos et al., 2022, "Africa."
- 31 See Section 9.11.2 in Trisos et al., 2022, "Africa." Also see: Trisos et al., 2022, "The IPCC's Sixth Assessment Report: Impacts, Adaptation Options and Investment Areas for a Climate-Resilient Southern Africa."
- 32 Boone, R.B. et al. 2018. "Climate Change Impacts on Selected Global Rangeland Ecosystem Services." *Global Change Biology* 24 (3): 1382–93. doi:10.1111/gcb.13995.
- 33 See Section 9.8.2.4 in Trisos et al., 2022, "Africa."
- 34 Richardson et al., 2022, "Climate Risk Report for the East Africa Region."
- 35 Mbow, C. et al. 2021. "Drylands." In *State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World*, 314–41. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- 36 IPCC. 2022. "Annex I: Global to Regional Atlas." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by H.-O. Pörtner et al., 2811–96. Cambridge, UK, and New York: Cambridge University Press (in press). <https://www.ipcc.ch/report/ar6/wg2/>.
- 37 See Section 9.8.5.2 in Trisos et al., 2022, "Africa." The median estimate for iron deficiencies is 11.1 million. The data are from: Golden, C.D. et al. 2016. "Nutrition: Fall in Fish Catch Threatens Human Health." *Nature* 534 (7607): 317–20. doi:10.1038/534317a.
- 38 See Section 9.8.5.2 and Figure 9.26 in Trisos et al., 2022, "Africa." See also Nyboer, E.A., C. Liang, and L.J. Chapman. 2019. "Assessing the Vulnerability of Africa's Freshwater Fishes to Climate Change: A Continent-Wide Trait-Based Analysis." *Biological Conservation* 236 (August): 505–20. doi:10.1016/j.biocon.2019.05.003.
- 39 See Section 9.8.5.2 and Figure 9.25 in Trisos et al., 2022, "Africa." See also the underlying study: Cheung, W.W.L., G. Reygondeau, and T.L. Frölicher. 2016. "Large Benefits to Marine Fisheries of Meeting the 1.5°C Global Warming Target." *Science* 354 (6319): 1591–94. doi:10.1126/science.aag2331.
- 40 Mbow et al., 2021, "Climate, Land, Agriculture and Biodiversity (CLAB-AFRICA): An African Initiative to Support Climate and Biodiversity Global Negotiations."
- 41 Trisos et al., 2022, "Africa."
- 42 Trisos et al., 2022, "Africa."
- 43 See Section 9.6.2 and Figure 9.19 in Trisos et al., 2022, "Africa."
- 44 See Section 9.6.2.2 in Trisos et al., 2022, "Africa." See also the underlying study: Urban, M.C. 2015. "Accelerating Extinction Risk from Climate Change." *Science* 348 (6234): 571–73. doi:10.1126/science.aaa4984.
- 45 See Section 9.6.2.4 and Figure 9.12 in Trisos et al., 2022, "Africa." The estimate is the average of values from two studies: Nyboer, Liang, and Chapman, 2019, "Assessing the Vulnerability of Africa's Freshwater Fishes to Climate Change: A Continent-Wide Trait-Based Analysis." Barbarossa, V. et al. 2021. "Threats of Global Warming to the World's Freshwater Fishes." *Nature Communications* 12 (1): 1701. doi:10.1038/s41467-021-21655-w.
- 46 See Section 9.6.2.3 in Trisos et al., 2022, "Africa." See also Hoegh-Guldberg, O. et al. 2018. "Impacts of 1.5°C of Global Warming on Natural and Human Systems." In *Global Warming of 1.5°C*. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty, edited by V. Masson-Delmotte et al. Geneva: Intergovernmental Panel on Climate Change. <https://www.ipcc.ch/sr15/>.
- 47 Trisos et al., 2022, "Africa."
- 48 See Section 9.6.1.1 and Figures 9.17 and 9.18 in Trisos et al., 2022, "Africa."
- 49 See Sections 9.7.1 and 9.7.2 in Trisos et al., 2022, "Africa."
- 50 Dickerson, S., M. Cannon, and B. O'Neill. 2022. "Climate Change Risks to Human Development in Sub-Saharan Africa: A Review of the Literature." *Climate and Development* 14 (6): 571–89. doi:10.1080/17565529.2021.1951644.
- 51 See Section 9.7.3 in Trisos et al., 2022, "Africa." See also Mbow et al., 2021, "Climate, Land, Agriculture and Biodiversity (CLAB-AFRICA): An African Initiative to Support Climate and Biodiversity Global Negotiations"; Richardson et al., 2022, "Climate Risk Report for the East Africa Region."

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- 52 Mbow et al., 2021, "Climate, Land, Agriculture and Biodiversity (CLAB-AFRICA): An African Initiative to Support Climate and Biodiversity Global Negotiations."
- 53 IPCC, 2022, "Annex I: Global to Regional Atlas."
- 54 See Section 9.9.4 in Trisos et al., 2022, "Africa."
- 55 See Section 9.9.4.3 in Trisos et al., 2022, "Africa." The underlying study is: Chinowsky, P. et al. 2013. "Climate Change Adaptation Advantage for African Road Infrastructure." *Climatic Change* 117 (1–2): 345–61. doi:10.1007/s10584-012-0536-z.
- 56 See Section 9.9.4.2 and Box 9.5 in Trisos et al., 2022, "Africa."
- 57 See Figure 9.28 in Trisos et al., 2022, "Africa."
- 58 See also Trisos et al., 2022, "The IPCC's Sixth Assessment Report: Impacts, Adaptation Options and Investment Areas for a Climate-Resilient Southern Africa."
- 59 Richardson et al., 2022, "Climate Risk Report for the East Africa Region."
- 60 See Section 9.9.4.1.2 in Trisos et al., 2022, "Africa."
- 61 See Section 9.10.2.3 and Figure 9.35 in Trisos et al., 2022, "Africa."
- 62 See Section 9.5.2.1.2 in Trisos et al., 2022, "Africa." The comparisons between children born in 1960 and 2020 are from: Thiery, W. et al. 2021. "Intergenerational Inequities in Exposure to Climate Extremes." *Science* 374 (6564): 158–60. doi:10.1126/science.abi7339.
- 63 Trisos et al., 2022, "Africa."
- 64 Richardson et al., 2022, "Climate Risk Report for the East Africa Region."
- 65 See Section 9.11.2 and Figure 9.37 in Trisos et al., 2022, "Africa."
- 66 Trisos et al., 2022, "The IPCC's Sixth Assessment Report: Impacts, Adaptation Options and Investment Areas for a Climate-Resilient Southern Africa."
- 67 See Section 9.11.1.2 in Trisos et al., 2022, "Africa."
- 68 See Section 9.12 in Trisos et al., 2022.
- 69 Trisos et al., 2022, "The IPCC's Sixth Assessment Report: Impacts, Adaptation Options and Investment Areas for a Climate-Resilient Southern Africa."

Adaptation Finance Flows in Africa

- 1 The focus of this analysis is on adaptation finance to address physical climate risks in Africa. It does not capture other important climate risks, such as transition risks associated with the shift towards lower-carbon economies.
- 2 CPI reports two-year averages (2019 and 2020) to smooth out annual fluctuations in data. The adaptation finance flows presented here are from a report produced by CPI in partnership with FSD Africa and the Children's Investment Fund Foundation: CPI. 2022. "The Landscape of Climate Finance in Africa." Climate Policy Initiative. <https://www.climatepolicyinitiative.org/publication/>.
- 3 OECD-CRS is used by members of the OECD Development Assistance Committee (DAC) to report on the provision of development finance. See <https://stats.oecd.org/Index.aspx?DataSetCode=crs1>.
- 4 For more information, please refer to the methodology of CPI, 2022.
- 5 Guzmán, S. et al. 2022. "The State of Climate Finance in Africa: Climate Finance Needs of African Countries." Climate Policy Initiative. <https://www.climatepolicyinitiative.org/publication/climate-finance-needs-of-african-countries/>.
- 6 The climate finance needs for the purposes of the study are defined as the cost of NDC implementation, minus committed financing from national governments.
- 7 GCA. 2021. "Global Center on Adaptation Releases New Research on the Benefits of Climate Adaptation for Africa." Global Center on Adaptation – News. October 26, 2021. <https://gca.org/news/global-center-on-adaptation-releases-new-research-on-the-benefits-of-climate-adaptation-for-africa/>.
- CAT. 2022. "Latest IPCC Report Is a Stark Warning of the Cost of Inaction on the Climate." Centre for Alternative Technology – News. March 2, 2022. <https://cat.org.uk/latest-ippc-report-is-a-stark-warning-of-the-cost-of-inaction-on-the-climate/>.
- 8 The high share of adaptation finance as a percentage of total climate finance in Africa, compared with other regions, may be attributable to a variety of factors, including, in particular, increasing prioritization by DFIs of adaptation finance in line with commitments to reach parity in adaptation and mitigation commitments.
- 9 CPI. 2021. "Global Landscape of Climate Finance 2021 – Methodology." Climate Policy Initiative. <https://www.climatepolicyinitiative.org/wp-content/uploads/2021/10/Methodology.pdf>.
- 10 Though the majority of multilateral DFI climate finance was committed to adaptation, other finance sources tracked were strongly mitigation-focused. For example, of the more than US\$1.5 billion annual average to climate finance from corporations in 2019–2020, less than 1 percent was committed to adaptation. Multilateral climate funds also committed finance predominantly to mitigation; only about 25 percent of multilateral climate funds commitments went to adaptation.
- 11 This trend is visible even after normalizing the data for changes in methodology and scope.
- 12 MDBs. 2019. "High Level MDB Statement." Issued at the UN Secretary-General's Climate Action Summit, September 22, 2019. New York: African Development Bank (AfDB), Asian Development Bank (ADB), Asian Infrastructure Investment Bank (AIIB), European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB), Inter-American Development Bank Group (IDBG), Islamic Development Bank (IsDB), New Development Bank (NDB), and World Bank Group (WBG). <https://www.iadb.org/document.cfm?id=EZSHARE-1729984378-16>.
- 13 Lee, N. and R. Aboneaaj. 2021. "MDBs to the Rescue? The Evidence on COVID-19 Response." CGD Note. Washington, DC: Center for Global Development. <https://www.cgdev.org/publication/mdbs-rescue-evidence-covid-19-response>.
- 14 UNFCCC. 2021. "COP26 Outcomes: Finance for Climate Adaptation." United Nations Framework Convention on Climate Change – Process and Meetings. December 2021. <https://unfccc.int/process-and-meetings/the-paris-agreement/the-glasgow-climate-pact/cop26-outcomes-finance-for-climate-adaptation>.
- 15 Gahouma-Bekale, T. 2021. "COP26 on Climate: Top Priorities for Africa." Africa Renewal (blog). July 12, 2021. <https://www.un.org/africarenewal/magazine/july-2021/cop26-climate-top-priorities-africa>.
- 16 For more details, see page 32 of: GCA. 2021. "Financial Innovation for Climate Adaptation in Africa." Produced in partnership with the Climate Policy Initiative. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/financial-innovation-for-climate-adaptation-in-africa/>.
- 17 UNEP. 2021. "Adaptation Gap Report 2021: The Gathering Storm – Adapting to Climate Change in a Post-Pandemic World." Nairobi: United Nations Environment Programme. <https://www.unep.org/resources/adaptation-gap-report-2021>.
- 18 UNCTAD. 2021. "World Investment Report 2021: Investing in Sustainable Recovery." Geneva: United Nations Conference on Trade and Development. <https://unctad.org/webflyer/world-investment-report-2021>.
- The report notes that there is potential for a return of FDI in Africa to pre-COVID-19 levels by 2022 given continued foreign investor engagement in a handful of large projects in 2020, pending containment of the worst potential economic and social impacts of the pandemic.
- 19 Fofack, H. 2021. "Downgrading Africa's Development." Project Syndicate, August 9, 2021. <https://www.project-syndicate.org/commentary/africa-credit-rating-downgrades-hurt-economic-development-by-hippolyte-fofack-2021-08>.
- 20 UNCTAD. 2022. "Investment Flows to Africa Reached a Record US\$83 Billion in 2021." United Nations Conference on Trade and Development – News. June 9, 2022. <https://unctad.org/news/investment-flows-africa-reached-record-83-billion-2021>. The Southern Africa region saw the most substantial increase in FDI, from US\$4 billion in 2020 to US\$42 billion in 2021.
- 21 CIF. 2016. "Private Sector Investment in Climate Adaptation in Developing Countries: Landscape, Lessons Learned and Future Opportunities." Report prepared by Vivid Economics. Washington, DC: Climate Investment Funds. https://www.climateinvestmentfunds.org/sites/default/files/7544-wb_cif_ppcr_report-v5.pdf.
- 22 See the AFAC page on the AfDB website: <https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/african-financial-alliance-on-climate-change-afac>.
- 23 EIB. 2021. Finance in Africa for Green, Smart and Inclusive Private Sector Development. Luxembourg: European Investment Bank. doi:10.2867/38529.
- 24 Invest In Africa. 2018. "Invest in Africa Launches SME Academy in Partnership with African Management Initiative." September 27, 2018. <https://investin africa.com/postdetail/155>.
- 25 EIB. 2021, Finance in Africa for Green, Smart and Inclusive Private Sector Development.
- 26 EIB. 2021.
- 27 ACPC. 2017. "Africa Is Spending More than Its Fair Share for Adaptation." Information brief. Addis Ababa: African Climate Policy Centre. http://www.climdev-africa.org/sites/default/files/DocumentAttachments/Information%20Brief-Adaptation%20COP23_New.pdf.
- 28 Guzmán et al., 2022, "The State of Climate Finance in Africa: Climate Finance Needs of African Countries."
- 29 MESTI. 2021. "Ghana: Updated Nationally Determined Contribution under the Paris Agreement (2020–2030)." Accra: Environmental Protection Agency, Ministry of Environment, Technology and Innovation. https://unfccc.int/sites/default/files/NDC/2022-06/Ghana%27s%20Updated%20Nationally%20Determined%20Contribution%20to%20the%20UNFCCC_2021.pdf.
- See also Mensah, R. 2020. "Ghana Ministry of Finance Presentation." West Africa Needs-based Finance (NBF) Technical Workshop, October 27. <https://unfccc.int/event/west-africa-needs-based-finance-nbf-technical-workshop>.
- 30 Republic of Rwanda. 2020. "Updated Nationally Determined Contribution." Kigali. https://unfccc.int/sites/default/files/NDC/2022-06/Rwanda_Updated_NDC_May_2020.pdf.
- 31 Bécault, E., M. Koenig, and A. Marx. 2016. "Getting Ready for Climate Finance: The Case of Rwanda." Working Paper No. 13. Leuven: Belgian Policy Research Group on Financing for Development. <https://www.befind.be/working-papers/wp13>.
- Mensah, 2020, "Ghana Ministry of Finance Presentation."
- UNFCCC. 2022. "Technical Assessment of Climate Finance in West Africa." Needs-based Climate Finance Project. Bonn: United Nations Framework Convention on Climate Change. <https://unfccc.int/documents/424108>.
- 32 The Global Center on Adaptation is working with the Ghana Infrastructure and Investment Fund to secure accreditation to enable the country to tap into the Green Climate Fund.
- 33 UNDP. 2021. "Ghana Launches Green Climate Fund Readiness Programme." United Nations Development Programme – Ghana. May 21, 2021. <https://www.undp.org/ghana/news/ghana-launches-green-climate-fund-readiness-programme>.
- 34 GCA, 2021, "Financial Innovation for Climate Adaptation in Africa."
- 35 Bécault, Koenig, and Marx, 2016, "Getting Ready for Climate Finance: The Case of Rwanda."
- 36 GCA, 2021, "Financial Innovation for Climate Adaptation in Africa."
- 37 Bécault, Koenig, and Marx, 2016, "Getting Ready for Climate Finance: The Case of Rwanda."
- 38 Republic of Rwanda. 2011. "Green Growth and Climate Resilience: National Strategy for Climate Change and Low Carbon Development." Kigali. <https://www.preventionweb.net/publication/rwanda-green-growth-and-climate-resilience-national-strategy-climate-change-and-low>.
- 39 Bécault, Koenig, and Marx, 2016, "Getting Ready for Climate Finance: The Case of Rwanda."
- 40 Mensah, 2020, "Ghana Ministry of Finance Presentation."

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- 41 NEPAD and UNECA. 2014. Mobilizing Domestic Financial Resources for Implementing NEPAD National and Regional Programmes & Projects: Africa Looks Within. Addis Ababa: New Partnership for Africa's Development and United Nations Economic Commission for Africa. <https://digitallibrary.un.org/record/781174>.
- 42 UNFCCC, 2022, "Technical Assessment of Climate Finance in West Africa."
- 43 Ahenkan, A., J. Osei, and E.H. Owusu. 2018. "Mainstreaming Green Economy: An Assessment of Private Sector Led Initiatives in Climate Change Adaptation in Ghana." *Journal of Sustainable Development* 11 (2): 77–87. doi:10.5539/jsd.v11n2p77. a purposive sampling technique was employed and a total of twenty-four respondents selected from 8 private sector organisations and some selected government ministries participated in the study. Data collected through in-depth interviews was transcribed, coded and analyzed thematically in line with the objectives and questions of the study. The study found out that green economy initiatives are not well mainstreamed in the private sector. Most companies' involvement in climate change and green economy activities was commonly carried out through corporate social responsibility (CSR)
- 44 Bécault, Koenig, and Marx, 2016, "Getting Ready for Climate Finance: The Case of Rwanda."
- 45 UNFCCC, 2022, "Technical Assessment of Climate Finance in West Africa," Bécault, Koenig, and Marx, 2016, "Getting Ready for Climate Finance: The Case of Rwanda."
- 46 Odhengo, P. et al. 2021. "The Landscape of Climate Finance in Kenya: On the Road to Implementing Kenya's NDC." Nairobi: The National Treasury, Climate Policy Initiative, and the Kenya Climate Innovation Centre. <https://www.climatepolicyinitiative.org/publication/the-landscape-of-climate-finance-in-kenya/>.
- 47 Beaubien, J. 2021. "Locust Swarms Threaten Parts Of East Africa." NPR, January 19, 2021. <https://www.npr.org/2021/01/19/958543535/locust-swarms-threaten-parts-of-east-africa>.
- 48 Balm, A. et al. 2022. "Blueprints for Climate Finance in Kenya." Climate Policy Initiative. <https://www.climatepolicyinitiative.org/publication/blueprints-for-climate-finance-in-kenya/>.
- 49 Republic of Kenya. 2016. "Kenya National Adaptation Plan 2015–2030." Nairobi: Ministry of Environment and Forestry. https://www4.unfccc.int/sites/NAPC/Documents%20NAP/Kenya_NAP_Final.pdf.
- 50 Odhengo et al., 2021, "The Landscape of Climate Finance in Kenya: On the Road to Implementing Kenya's NDC."
- 51 Balm et al., 2022, "Blueprints for Climate Finance in Kenya."
- 52 The most recent, reliable domestic public climate finance data are for 2018. See Odhengo et al., 2021, "The Landscape of Climate Finance in Kenya: On the Road to Implementing Kenya's NDC." Data for 2020 are available only for international finance flows and have not yet been formally published.
- 53 The 2018 data had limited expenditure data from the SAGAs, because they have a different budget system and are not required to report their expenditures through the central government's public financial management system. See Odhengo et al., 2021. Using the data for 2018, expenditures were manually reviewed and tagged as targeting mitigation and/or adaptation outcomes if that was fundamental in the design or motivation for the activity, including it being stated in the project description, objectives, or rationale. Much of the data lacked sufficient descriptive detail to assess their climate relevance, so some expenditures were classified as 100 percent contributing to a mitigation/adaptation objective, while others counted for 40 percent, when in reality it may have been much lower. This problem was especially pronounced in determining adaptation relevance, due to definitional issues, further limiting visibility into how climate finance was channeled.
- 54 Odhengo et al., 2021.
- 55 Odhengo et al., 2021.
- 56 Republic of Kenya. 2016. "Kenya National Adaptation Plan 2015–2030." Nairobi: Ministry of Environment and Forestry. https://www4.unfccc.int/sites/NAPC/Documents%20NAP/Kenya_NAP_Final.pdf.
- 57 Rohini, K. and A. Mozaharul. 2018. "National Adaptation Plans in Focus: Lessons from Egypt." UNDP-UN Environment National Adaptation Plan Global Support Programme. Nairobi: United Nations Development Programme. <https://www.adaptation-undp.org/resources/project-brief-fact-sheet/national-adaptation-plan-process-focus-lessons-egypt>.
- 58 Ministry of Finance. 2021. "Egypt Sovereign Green Bond Allocation & Impact Report 2021." Prepared by the Green Financing Working Group. Cairo. <https://assets.mof.gov.eg/files/a3362b50-574c-11ec-9145-6f33c8bd6a26.pdf>.
- 59 World Bank. 2018. "Seychelles Launches World's First Sovereign Blue Bond." Press Releases. October 29, 2018. <https://www.worldbank.org/en/news/press-release/2018/10/29/seychelles-launches-worlds-first-sovereign-blue-bond>.
- 60 Dzawu, M.M. 2022. "Fintech Entrepreneurs Aim to Spur Green Bond Issuance in Africa." Bloomberg, February 22, 2022. <https://www.bloomberg.com/news/articles/2022-02-22/fintech-entrepreneurs-aim-to-spur-green-bond-issuance-in-africa>.
- 61 Climate Bonds Initiative. 2019. "Climate Resilience Principles: A Framework for Assessing Climate Resilience Investments." Prepared with the Climate Resilience Consulting and World Resources Institute, based on input and advice from the Adaptation and Resilience Working Group (AREG). <https://www.climatebonds.net/files/page/files/climate-resilience-principles-climate-bonds-initiative-20190917-.pdf>.
- 62 CIB. 2021. "Green Bond Framework." Cairo: Commercial International Bank. <https://www.cibeg.com/-/media/project/downloads/about-cib/cib-corporate-responsibility-formerly-community/corporate-sustainability/green-bond/green-bond-framework-v3.pdf>.
- 63 IFC. 2017. "IFC's Definitions and Metrics for Climate-Related Activities." Version 3.1. Washington, DC: International Finance Corporation, Climate Business Department. <https://blogs.worldbank.org/voices/cafi-how-improve-transparency-climate-reporting-financial-services-industry>.
- 64 CIB, 2021, "Green Bond Framework."
- 65 Ministry of Finance, 2021, "Egypt Sovereign Green Bond Allocation & Impact Report 2021."
- 66 CIB, 2021, "Green Bond Framework."
- 67 Ministry of Finance, 2021, "Egypt Sovereign Green Bond Allocation & Impact Report 2021."
- 68 CIB, 2021, "Green Bond Framework."
- 69 CIB, 2021.
- 70 Ministry of Finance, 2021, "Egypt Sovereign Green Bond Allocation & Impact Report 2021."
- 71 Ministry of Finance, 2021.
- 72 CIB, 2021, "Green Bond Framework"; Ministry of Finance, 2021, "Egypt Sovereign Green Bond Allocation & Impact Report 2021"; see also Samak, N. 2021. "Egyptian Sovereign Green Bonds." IDSC Policy Perspective. Cairo: The Egyptian Cabinet, Information and Decision Support Center. https://idsc.gov.eg/Upload/DocumentLibrary/Attachment_A/5904/12-Egyptian%20Sovereign%20Green%20Bonds.pdf.
- 73 GCA. 2021. "Financial Innovation for Climate Adaptation in Africa." Produced in partnership with the Climate Policy Initiative. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/financial-innovation-for-climate-adaptation-in-africa/>.
- 74 Samak, 2021, "Egyptian Sovereign Green Bonds."
- 75 Schneider, T. 2014. "Responsibility for Private Sector Adaptation to Climate Change." *Ecology and Society* 19 (2): Art. 8. doi:10.5751/ES-06282-190208.
- 76 Onu, E. and J. Ryan. 2021. "African Banks Face US\$218 Billion of Climate Change Risk." Bloomberg, March 22, 2021. <https://www.bloomberg.com/news/articles/2021-03-22/moody-s-flags-environmental-risk-on-218-billion-of-africa-loans>.
- 77 UNECA. 2021. "Building Forward for an African Green Recovery." Addis Ababa: United Nations Economic Commission for Africa. <https://hdl.handle.net/10855/43948>.
- 78 For an analysis of the debt-for-adaptation swaps, including eligibility and condition criteria, principles for using proceeds from swaps, and concrete opportunities for using the redirected flows in select countries, see: Singh, D. and V. Widge. 2021. "Debt for Climate Swaps: Supporting a Sustainable Recovery." Climate Policy Initiative. <https://www.climatepolicyinitiative.org/publication/debt-for-climate-swaps/>.

Fiscal Policies for Adaptation: IMF Perspective

- 1 Bellon, M. and E. Massetti. 2022. "Economic Principles for Integrating Adaptation to Climate Change into Fiscal Policy." IMF Staff Climate Note 2022/001. Washington, DC: International Monetary Fund. <https://www.imf.org/en/Publications/staff-climate-notes/Issues/2022/03/10/Economic-Principles-for-Integrating-Adaptation-to-Climate-Change-into-Fiscal-Policy-464314>.
- Aligishiev, Z., E. Massetti, and M. Bellon. 2022. "Macro-Fiscal Implications of Adaptation to Climate Change." IMF Staff Climate Note 2022/002. Washington, DC: International Monetary Fund. <https://www.imf.org/en/Publications/staff-climate-notes/Issues/2022/03/16/Macro-Fiscal-Implications-of-Adaptation-to-Climate-Change-512769>.
- Massetti, E. and M. Bellon. 2022. "Planning and Mainstreaming Adaptation to Climate Change in Fiscal Policy." IMF Staff Climate Note 2022/003. Washington, DC: International Monetary Fund. <https://www.imf.org/en/Publications/staff-climate-notes/Issues/2022/03/16/Planning-and-Mainstreaming-Adaptation-to-Climate-Change-in-Fiscal-Policy-512776>.
- 2 Bellon and Massetti. 2022.
- 3 Aligishiev et al. 2022.
- 4 Ibid. See Figure 3. While the costs for advanced economies are estimated at less than 0.1 and 0.3 percent per year, for instance, for low-income countries they are estimated at about 0.2 and 0.4 percent, and for emerging economies at more than 0.3 and 0.8 percent.
- 5 Ibid. See Annex Figure 2.1. The estimated cost of protecting existing private sector assets from storm and flood risks exceeds 0.4 percent of GDP in advanced economies and 0.6 percent in emerging economies and low-income countries, and approaches 1 percent of GDP in small developing states.
- 6 Bellon and Massetti. 2022.
- 7 Massetti and Bellon. 2022.
- 8 Ibid.

Financial Instruments in North Africa

- 1 For this chapter, seven countries are considered part of North Africa: Algeria, Egypt, Libya, Mauritania, Morocco, Sudan and Tunisia.
- 2 More details on how financing needs can be assessed are provided in: UNFCCC. 2022. "Technical Assessment of Climate Finance in the Arab States: Annex to the Arab States Climate Finance Access and Mobilization Strategy." Needs-based Climate Finance Project. Bonn: United Nations Framework Convention on Climate Change. https://unfccc.int/sites/default/files/resource/UNFCCC_NBF_TA_AS_final.pdf.
- 3 Chapagain, D. et al. 2020. "Climate Change Adaptation Costs in Developing Countries: Insights from Existing Estimates." *Climate and Development* 12 (10): 934–42. doi:10.1080/17565529.2020.111698.
- 4 Algeria has not specified any cost estimates in its NDC, and Libya has not yet submitted an initial NDC.

Financial Instruments in North Africa

continued

- 5 In this chapter, climate finance flows to North Africa are calculated by the ESCWA team based on data from the Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC)—in particular, for climate-related development finance, recipient perspective, for 2000 to 2020. See <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>. The numbers in this chapter may be slightly different from the numbers for recent climate finance flows in the Africa-wide finance chapter, which are based on the Climate Policy Initiative's latest Landscape of Climate Finance in Africa, published in August 2022. Climate Policy Initiative numbers collate more sources and are based on a related, but different methodology.
- 6 See <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>; note 5 provides more details on how this differs from finance data used elsewhere in this report.
- 7 Savidou, G. et al. 2021. "Quantifying International Public Finance for Climate Change Adaptation in Africa." *Climate Policy* 21 (8): 1020–36. doi:10.1080/14693062.2021.1978053.
- 8 Savidou et al., 2021.
- 9 See <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>; note 5 provides more details on how this differs from finance data used elsewhere in this report.
- 10 ESCWA calculations based on OECD DAC data (recipient perspective). See <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>; note 5 provides more details on how this differs from finance data used elsewhere in this report. (
- 11 See <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>; note 5 provides more details on how this differs from finance data used elsewhere in this report.
- 12 Aligishiev, Z., E. Massetti, and M. Bellon. 2022. "Macro-Fiscal Implications of Adaptation to Climate Change." IMF Staff Climate Note 2022/002. Washington, DC: International Monetary Fund. <https://www.imf.org/en/Publications/staff-climate-notes/Issues/2022/03/16/Macro-Fiscal-Implications-of-Adaptation-to-Climate-Change-512769>.
- 13 In addition to Algeria, Egypt, Morocco and Tunisia, the figures presented here also include calculations for Jordan and Lebanon.
- 14 ESCWA. 2021. "Liquidity Shortage and Debt: Obstacles to Recovery in the Arab Region." Policy brief. Beirut: United Nations Economic and Social Commission for Western Asia. <http://www.unescwa.org/publications/liquidity-shortage-debt-obstacles-recovery-arab-region>.
- 15 Arab Republic of Egypt. 2022. "Egypt National Climate Change Strategy (NCCS) 2050." Summary for Policymakers. Cairo: Ministry of Environment. <https://www.eea.gov.gov/portals/0/eeaaReports/N-CC/EgyptNCCS-2050-Summary-En.pdf>.
- 16 Bank Al-Maghrib. 2016. "Roadmap for Aligning the Moroccan Financial Sector with Sustainable Development." Rabat. <https://www.bkam.ma/en/content/download/462869/3754811/>.
- 17 MAPMDREF. 2021. "Plan Maroc Vert : Bilan et Impacts 2008–2018." Rabat: Ministère de l'Agriculture, de la Pêche Maritime, du Développement Rural et des Eaux et Forêts. <https://www.agriculture.gov.ma/fr/publications/plan-maroc-vert-bilan-et-impacts>.
- 18 See, for example, Tunisia's Government Decree No. 2018-263 to operationalise the implementation of the Paris Agreement: <https://www.climate-laws.org/geographies/tunisia/policies/government-decree-no-2018-263-to-operationalise-the-implementation-of-the-paris-agreement>, or Morocco's Decree N° 2.19.721 establishing the National Climate Change and Biodiversity Commission: <https://www.climate-laws.org/geographies/morocco/policies/decree-n-2-19-721-establishing-the-national-climate-change-and-biodiversity-commission>.
- 19 See the list of supporters at <https://www.fsb-tcfd.org/supporters/>.
- 20 Bank Al-Maghrib. 2021. "Directive Relative Au Dispositif de Gestion Des Risques Financiers Liés Au Changement Climatique et à l'environnement." Rabat. <https://www.bkam.ma/content/download/729100/8334120/Directive%20n%C2%B0%205W21%20Risques%20financiers%20li%C3%A9s%20%C3%A0%20l'environnement.pdf>.
- 21 ESCWA and Islamic Development Bank. 2022 (forthcoming). "Mainstreaming Climate Action into National Development Planning in the Arab Region." Beirut: United Nations Economic and Social Commission for Western Asia.
- 22 Bird, N. et al. 2012. "Climate Public Expenditure and Institutional Review (CPEIR): A Methodological Note." Joint UNDP/ODI Working Paper. Nairobi and London: United Nations Development Programme and Overseas Development Institute. https://www.researchgate.net/publication/272791308_The_Climate_Public_Expenditure_and_Institutional_Review_CPEIR_a_methodology_to_review_climate_policy_institutions_and_expenditure.
- 23 World Bank. 2013. "Royaume Du Maroc: Revue Des Dépenses Publiques et Analyse Institutionnelle de La Politique Climat [Kingdom of Morocco: Public Expenditure Review and Institutional Analysis of the Climate Policy]." Program of analytical support to Morocco's climate change strategy. Washington, DC: World Bank. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail>.
- 24 See <https://www.adaptation-undp.org/projects/bf-morocco-nama>.
- 25 Smith, Barry. 2019. "Subnational Adaptation Monitoring and Evaluation in Morocco." Case study for the Partnership on Transparency in the Paris Agreement. London: International Institute for Environment and Development. <https://www.iiied.org/subnational-adaptation-monitoring-evaluation-morocco>.
- 26 ESCWA, UNDP, and UNICEF. 2022 (forthcoming). "Social Expenditure Monitor for Arab States – Toward Making Public Budgets More Equitable, Efficient and Effective to Achieve the SDGs." Beirut: United Nations Economic and Social Commission for Western Asia, United Nations Development Programme, and United Nations Children's Fund.
- 27 World Bank. 2021. "Building Morocco's Resilience to Natural and Climate-Related Disasters: World Bank Additional Financing to Protect against Risks." Press release. June 11. <https://www.worldbank.org/en/news/press-release/2021/06/11/building-morocco-s-resilience-to-natural-and-climate-related-disasters-world-bank-additional-financing-to-protect-against>.
- 28 Arab Republic of Egypt. 2022. "Environmental Sustainability Standards Guide." Cairo: Ministry of Planning and Economic Development. <https://mped.gov.eg/DynamicPage?id=95&lang=en>.
- 29 World Bank. 2021. "Morocco – Second Financial and Digital Inclusion Development Policy Financing." Program document. Washington, DC: World Bank Group. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/798401624240940310/Morocco-Second-Financial-and-Digital-Inclusion-Development-Policy-Financing>.
- 30 Smith, Benjamin. 2021. "Study on the Involvement of the Private Sector in Financing Climate Adaptation Actions." Report prepared for the European Commission. Bristol, UK: WS Atkins International Limited. https://europa.eu/capacity4dev/file/123578/download?token=rQWL_RBU.
- 31 UNDP and Kingdom of Morocco. 2021. "Supporting the Foundations for Sustainable Adaptation Planning and Financing in Morocco." Readiness proposal to the Green Climate Fund. Rabat: Prepared by the United Nations Development Programme and the Ministry of Energy, Mining and Sustainable Development. <https://www.greenclimate.fund/document/supporting-foundations-sustainable-adaptation-planning-and-financing-morocco>.
- 32 See the brief summary "Compulsory Disaster Insurance in Morocco" by the Jean Monnet Project Disseminating Disaster Law for Europe: <https://www.dilaw4.eu/developments/compulsory-disaster-insurance-in-morocco/>, and Atlas Magazine. 2018. "Natural Catastrophe Insurance Will Soon See the Light of Day in Morocco." January 5. <https://atlas-mag.net/en/article/natural-catastrophe-insurance-will-soon-see-the-light-of-day-in-morocco>.
- 33 ESCWA and Islamic Development Bank. 2022 (forthcoming). "Mainstreaming Climate Action into National Development Planning in the Arab Region." Beirut: United Nations Economic and Social Commission for Western Asia.
- 34 Climate Action Tracker. 2022. "Climate Governance: An Assessment of the Government's Ability and Readiness to Transform Egypt into a Zero Emissions Society." Prepared by Climate Analytics and the NewClimate Institute. https://climateactiontracker.org/documents/1027/CAT_2022_03_ClimateGovernance_Egypt.pdf.
- 35 UNFCCC, 2022. "Technical Assessment of Climate Finance in the Arab States: Annex to the Arab States Climate Finance Access and Mobilization Strategy."
- 36 See, for example: GCA. 2021. "Green Bonds for Climate Resilience: A Guide for Issuers." Rotterdam: Prepared by the Climate Bonds Initiative for the Global Center on Adaptation, in cooperation with the European Bank for Reconstruction and Development. <https://gca.org/reports/green-bonds-for-climate-resilience-a-guide-for-issuers/>.
- 37 Vigeo Eiris. 2021. "Independent Review of the Management of the Arab Republic of Egypt's Green Bond Issued in 2020." Cairo. <https://assets.mof.gov.eg/files/2022-06/22c46be0-e7ce-11ec-b91f-233f81beb839.pdf>.
- 38 For a discussion, see Climate Action Tracker, 2022, "Climate Governance: An Assessment of the Government's Ability and Readiness to Transform Egypt into a Zero Emissions Society."
- 39 ESCWA and Islamic Development Bank. 2022 (forthcoming). "Mainstreaming Climate Action into National Development Planning in the Arab Region." Beirut: United Nations Economic and Social Commission for Western Asia.
- 40 Mustafa, N. 2022. "Egypt, KfW Ink Development Financing Deal Worth €26 Million." Sala ElBalad English, April 21. <https://see.news/egypt-kfw-ink-development-financing-deal-worth-e26-milli/>.
- EgyptToday. 2021. "Germany Provides Egypt €41M as Part of Debt Swap Program for Developing Technical Education." July 25. <https://www.egypttoday.com/Article/3/106292/Germany-provides-Egypt-€41M-as-part-of-debt-swap-program>.
- 41 See description on the website of the Italian Development Agency for Cooperation: <https://ilcairo.aics.gov.it/home/country/debt-swap/>.
- 42 See the ESCWA web page on the Climate/SDGs Debt Swap – Donor Nexus Initiative: <https://www.unescwa.org/debt-swap>.
- 43 ESCWA. 2022. "A Regional Framework for a Debt Swap Mechanism and Key Performance Indicators for Climate Action/SDGs Progress in the Arab Region." Beirut: United Nations Economic and Social Commission for Western Asia. <http://www.unescwa.org/publications/regional-framework-debt-swap-mechanism-performance-indicators-climate-arab-region>.
- 44 ESCWA. 2020. "Climate/SDGs Debt Swap Mechanism." Beirut: United Nations Economic and Social Commission for Western Asia. https://www.unescwa.org/sites/default/files/pubs/pdf/climate-sdgs-debt-swap-mechanism-english_0.pdf.
- 45 ESCWA calculations based on OECD DAC data (recipient perspective) See <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm>; note 5 provides more details on how this differs from finance data used elsewhere in this report.
- 46 IsDB. 2020. "Annual Impact Report on IsDB Debut Green Sukuk." Jeddah, Saudi Arabia: Islamic Development Bank. <https://www.isdb.org/publications/annual-impact-report-on-isdb-debut-green-sukuk-dec-2020>.
- 47 See the Clean Technology Fund page on the CIF website: <https://www.climateinvestmentfunds.org/topics/clean-technologies>.
- 48 See for example Zgheib, N. (2022). EBRD, GCF and EU promote climate mitigation and adaptation in Morocco, accessible from: <https://www.ebrd.com/news/2022/ebrd-gcf-and-eu-promote-climate-mitigation-and-adaptation-in-morocco.html> or EBRD and GEFF (2022). EBRD and GCF boost green economy and value chains in Morocco, accessible from: <https://ebrdgeff.com/morocco/ebrd-and-gcf-boost-green-economy-and-value-chains-in-morocco/>.
- 49 See the webpage of the GCF for an overview of funded projects by country: <https://www.greenclimate.fund/countries>.
- 50 UNFCCC, 2022. "Technical Assessment of Climate Finance in the Arab States: Annex to the Arab States Climate Finance Access and Mobilization Strategy."
- 51 UNFCCC, ESCWA, League of Arab States (LAS) and Council of Arab Ministers Responsible for the Environment (CAMRE). 2022 (forthcoming). Arab Climate Finance Access and Mobilization Strategy 2022–2030.
- 52 RICCAR is the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region. See the project website: <https://www.riccar.org>.

Financial Instruments in North Africa

continued

53 Pillay, K., S. Aakre, and A. Torvanger. 2017. "Mobilizing Adaptation Finance in Developing Countries." CICERO Report 2017:02. Oslo: Center for International Climate and Environmental Research – Oslo (CICERO). <http://hdl.handle.net/11250/2435614>.

54 Carney, M. 2015. "Breaking the Tragedy of the Horizon: Climate Change and Financial Stability." Speech given at Lloyd's of London, September 29. London: Bank of England. <http://www.bankofengland.co.uk/speech/2015/breaking-the-tragedy-of-the-horizon-climate-change-and-financial-stability>.

55 Pillay, Aakre, and Torvanger, 2017, "Mobilizing Adaptation Finance in Developing Countries."

56 Bhandary, R.R., K.S. Gallagher, and F. Zhang. 2021. "Climate Finance Policy in Practice: A Review of the Evidence." *Climate Policy* 21 (4): 529–45. doi:10.1080/14693062.2020.1871313.

57 Pillay, Aakre, and Torvanger, 2017, "Mobilizing Adaptation Finance in Developing Countries."

Climate Risk Regulation in Africa

1 Stenek, V., J.C. Amado, and R. Connell. 2011. "Climate Risk and Financial Institutions: Challenges and Opportunities." Washington, DC: International Finance Corporation. <http://hdl.handle.net/10986/27888>.

2 "Africa: Banks begin to take stock of intensifying environmental threats" (paid subscription required; March 23, 2021). https://www.moody.com/researchdocumentcontentpage.aspx?docid=PBC_1230792.

Or see: Onu, E. and J. Ryan. 2021. "African Banks Face \$218 Billion of Climate Change Risk." Bloomberg, March 22. <https://www.bloomberg.com/news/articles/2021-03-22/moody-s-flags-environmental-risk-on-218-billion-of-africa-loans>.

3 AfDB, GCA, and UNEP FI. 2021. "Climate Risk Regulation in Africa's Financial Sector and Related Private Sector Initiatives." Baseline study November 2021. African Development Bank, Global Center on Adaptation, and United Nations Environment Programme Finance Initiative. <https://gca.org/reports/climate-risk-regulation-in-africas-financial-sector-and-related-private-sector-initiatives/>.

4 Zeufack, A.G. et al. 2021. "Climate Change Adaptation and Economic Transformation in Sub-Saharan Africa." *Africa's Pulse*, No. 24, October 2021: An Analysis of Issues Shaping Africa's Economic Future. Washington, DC: World Bank. <http://hdl.handle.net/10986/36332>.

5 See Section 9.11 in Trisos, C.H. et al. 2022. "Africa." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by H.-O. Pörtner et al., 1285–1455. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.

6 Eckstein, D., V. Künzel, and L. Schäfer. 2021. "Global Climate Risk Index 2021: Who Suffers Most From Extreme Weather Events? Weather-Related Loss Events in 2019 and 2000–2019." Briefing Paper. Bonn: Germanwatch. <https://www.germanwatch.org/en/19777>.

7 Carney, M. 2015. "Breaking the Tragedy of the Horizon: Climate Change and Financial Stability." Speech given at Lloyd's of London, September 29. London: Bank of England. <http://www.bankofengland.co.uk/speech/2015/breaking-the-tragedy-of-the-horizon-climate-change-and-financial-stability>.

8 See <https://www.fsb-tcfd.org/>.

9 Climate-related financial risks: a survey on current initiatives: <https://www.bis.org/bcb/publ/d502.pdf>

10 Regelin, M. et al. 2017. "Waterproof? An Exploration of Climate-Related Risks for the Dutch Financial Sector." Amsterdam: De Nederlandsche Bank. <https://www.dnb.nl/media/r40dggfap/waterproof-an-exploration-of-climate-related-risks-for-the-dutch-financial-sector.pdf>.

Scott, M., J. van Huizen, and C. Jung. 2017. "The Bank's Response to Climate Change." Bank of England Quarterly Bulletin, June 16. <https://www.bankofengland.co.uk/quarterly-bulletin/2017/q2/the-banks-response-to-climate-change>.

11 Frisari, G.L. et al. 2019. "Climate Risk and Financial Systems of Latin America: Regulatory, Supervisory and Industry Practices in the Region and Beyond." Washington, DC: Inter-American Development Bank. <http://dx.doi.org/10.18235/0002046>.

12. NGFS. 2021. "NGFS Climate Scenarios for Central Banks and Supervisors." Network for Greening the Financial System. <https://www.ngfs.net/en/ngfs-climate-scenarios-central-banks-and-supervisors-june-2021> (license: <https://data.ene.iiasa.ac.at/ngfs/#/license>).

13 See <https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/africa-ndc-hub> as well as the official NDC Registry: <https://unfccc.int/NDCREG>.

14 AfDB, GCA, and UNEP FI, 2022, "Climate Risk Regulation in Africa's Financial Sector and Related Private Sector Initiatives."

Resilient Recovery: Senegal and Côte d'Ivoire

1 IMF. 2022. "Senegal: Fifth Review Under the Policy Coordination Instrument, Second Reviews Under the Stand-By Arrangement and the Arrangement Under the Standby Credit Facility, and Requests for Augmentation of Access, Waiver of the Nonobservance of a Performance Criterion, and Modification of a Performance Criterion and Quantitative Targets-Press Release; Staff Report; and Statement by the Executive Director for Senegal." Country Report No. 2022/197. Washington, DC: International Monetary Fund. <https://www.imf.org/en/Publications/CR/Issues/2022/06/27/Senegal-Fifth-Review-Under-the-Policy-Coordination-Instrument-Second-Reviews-Under-the-520104>.

2 IMF. 2022. "Côte d'Ivoire: 2022 Article IV Consultation-Press Release; and Staff Report." Country Report No. 2022/205. Washington, DC: International Monetary Fund. <https://www.imf.org/en/Publications/CR/Issues/2022/07/01/Cte-divoire-2022-Article-IV-Consultation-Press-Release-and-Staff-Report-520258>.

3 GCA. 2021. State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.

See also GCA. 2021. "Financial Innovation for Climate Adaptation in Africa." Produced in partnership with the Climate Policy Initiative. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/financial-innovation-for-climate-adaptation-in-africa/>.

4 This chapter is based on a background paper prepared by the United Nations Economic Commission for Africa (UNECA) and Moulaye Bamba. The modeling analysis was performed by Moulaye Bamba from B2LH Consulting.

5. Garrett-Peltier, H. 2017. "Green versus Brown: Comparing the Employment Impacts of Energy Efficiency, Renewable Energy, and Fossil Fuels Using an Input-Output Model." *Economic Modelling* 61 (February): 439–47. doi:10.1016/j.econmod.2016.11.012.

6 World Bank. 2022. "Macro Poverty Outlook, Spring Meetings 2022: Country-by-Country Analysis and Projections for the Developing World." Washington, DC: World Bank. <http://hdl.handle.net/10986/37346>.

7 IFC. 2020. "Creating Markets in Senegal: Country Private Sector Diagnostic." Country Private Sector Diagnostic. Washington, DC: International Finance Corporation. https://www.ifc.org/wps/wcm/connect/Publications_EXT_Content/IFC_External_Publication_Site/Publications_Listing_Page/CPSD-Senegal.

8 ANSD. 2022. "Situation Economique et Sociale Du Sénégal." Dakar: Agence Nationale de la Statistique et de la Démographie. https://www.ansd.sn/ressources/ses/SES_2019.pdf.

9 République du Sénégal. 2018. "Plan Sénégal Émergent: Plan d'Actions Prioritaires 2019–2023." Dakar: Ministère de l'Économie, des Finances et du Plan. <https://www.economie.gouv.sn/en/dossiers-publications/publications/pspe>.

10 IMF. 2022. "Senegal: Fifth Review Under the Policy Coordination Instrument, Second Reviews Under the Stand-By Arrangement and the Arrangement Under the Standby Credit Facility, and Requests for Augmentation of Access, Waiver of the Nonobservance of a Performance Criterion, and Modification of a Performance Criterion and Quantitative Targets-Press Release; Staff Report; and Statement by the Executive Director for Senegal." See also the HDI data page for Senegal: <https://hdr.undp.org/data-center/specific-country-data/#/countries/SEN>.

11 IFC, 2020, "Creating Markets in Senegal: Country Private Sector Diagnostic."

12 IMF. 2022. "Senegal: Fifth Review Under the Policy Coordination Instrument, Second Reviews Under the Stand-By Arrangement and the Arrangement Under the Standby Credit Facility, and Requests for Augmentation of Access, Waiver of the Nonobservance of a Performance Criterion, and Modification of a Performance Criterion and Quantitative Targets-Press Release; Staff Report; and Statement by the Executive Director for Senegal." See also the HDI data page for Senegal: <https://hdr.undp.org/data-center/specific-country-data/#/countries/SEN>.

13 ANSD, 2022, "Situation Economique et Sociale Du Sénégal."

14 World Bank Group. 2014. "Situation Économique Du Sénégal : Apprendre Du Passé Pour Un Avenir Meilleur." Senegal Economic Update, December 2014. Washington, DC: World Bank. <http://hdl.handle.net/10986/21504>.

15 CSE. 2020. "Rapport Sur l'état de l'environnement Au Sénégal." Dakar: Ministère de l'Environnement et du Développement Durable, Centre de Suivi Écologique. https://www.pseau.org/outils/ouvrages/cse_rapport_sur_l_etat_de_l_environnement_la_senegal_2020.pdf.

16 See Johns Hopkins University Coronavirus Resource Center: <https://coronavirus.jhu.edu/data/mortality>.

17 See International Monetary Fund (IMF) COVID-19 Policy Tracker, last updated July 2, 2021: <https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19>.

18 See project web page (in French): "Appuyer une gestion intégrée des inondations au Sénégal" [Supporting integrated flood management in Senegal]. <https://www.afd.fr/fr/carte-des-projets/appuyer-une-gestion-integree-des-inondations-au-senegal> [accessed 2 March 2022].

19 SUEZ Group. 2022. "In Senegal, SUEZ Wins the Contract to Design and Build an Urban and Industrial Wastewater Treatment Plant at Hann Bay in Dakar." Press Releases, May 4. <https://www.suez.com/en/news/press-releases/in-senegal-suez-wins-the-contract-to-design-and-build-an-urban-and-industrial-wastewater-treatment-plant-hann-bay-dakar>.

20 D'Abramo, L.R. and M.J. Slater. 2019. "Climate Change: Response and Role of Global Aquaculture." *Journal of the World Aquaculture Society* 50 (4): 710–14. doi:10.1111/jwas.12643.

21 Diouf, B. et al., eds. 2014. Pour une agriculture intelligente face au climat au Sénégal, un recueil de bonnes pratiques d'adaptation et d'atténuation publié. Document de Travail No. 85. Copenhagen: Programme de Recherche du CGIAR sur le Changement Climatique, l'Agriculture et la Sécurité Alimentaire. <https://hdl.handle.net/10568/51331>.

22 République du Sénégal. 2020. "Contribution Déterminée Au Niveau National Du Sénégal [Nationally Determined Contribution of Senegal]." Dakar. <https://unfccc.int/sites/default/files/NDC/2022-06/CDNSenegal%20approuv%C3%A9e.pdf>.

See also Hammond, A. et al. 2015. "Improving Gender Equality and Rural Livelihoods in Senegal through Sustainable and Participatory Energy Management: Senegal's PROGEDE II Project." Live Wire, 2015/40. Washington, DC: World Bank. <http://hdl.handle.net/10986/22111>.

23 Magdelaine, C. 2019. "Le Sénégal mène la plus grande campagne mondiale de reforestation de mangrove." Notre-Planète.info, September 12. <https://www.notre-planete.info/actualites/3088-Senegal-reforestation-plantation-mangrove>.

Resilient Recovery: Senegal and Côte d'Ivoire *continued*

- 24 MAER. 2014. "Programme d'Accélération de La Cadence de l'Agriculture Sénégalaise (PRACAS)." Dakar: Ministère de l'Agriculture et de l'Équipement Rural. <https://www.maer.gouv.sn/programme-dacceleration-de-la-cadence-de-lagriculture-senegalaise-pracas/>.
- 25 Sanogo, D. et al. 2019. "Les Utilisateurs Des Terres de Kaffrine Gagnent à Investir Dans Des Pratiques de Gestion plus Durables: Exemple Du Village Climato-Intelligent de Daga Birame et Sa Plateforme d'innovation." The Economics of Land Degradation Initiative report. Dakar. <https://www.eld-initiative.org/fileadmin/pdf/ELD-4-Senegal-ISRA-web.pdf>.
- 26 République du Sénégal. 2019. "Lettre de Politique de Développement Du Secteur de l'Énergie 2019-2023 [Energy Sector Development Policy Letter (2019-2023)]." Dakar: Ministère du Pétrole et des Énergies. <https://www.iea.org/policies/13390-energy-sector-development-policy-letter-2019-2023>.
- 27 World Bank. 2020. "Taking Stock and Looking Ahead: Cote d'Ivoire and the COVID-19 Pandemic." Cote d'Ivoire 10th Economic Update. Washington, DC: World Bank. <https://openknowledge.worldbank.org/handle/10986/34559>.
- 28 IMF, 2022, "Côte d'Ivoire: 2022 Article IV Consultation-Press Release; and Staff Report."
- 29 IMF, 2022.
- 30 World Bank, 2020, "Taking Stock and Looking Ahead: Cote d'Ivoire and the COVID-19 Pandemic."
- 31 World Bank, 2020.

The Private Sector

- 1 Bouchene, L. et al. 2021. "Green Africa: A Growth and Resilience Agenda for the Continent." Executive Briefing. McKinsey & Company. <https://www.mckinsey.com/capabilities/sustainability/our-insights/green-africa-a-growth-and-resilience-agenda-for-the-continent>.
- 2 Trisos, C.H. et al. 2022. "Africa." In Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by H.-O. Pörtner et al., 1285–1455. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.
- 3 Jafino, B.A. et al. 2020. "Revised Estimates of the Impact of Climate Change on Extreme Poverty by 2030." Policy Research Working Paper No. 9417. Washington, DC: World Bank. <http://hdl.handle.net/10986/34555>.
- 4 Trisos et al., 2022, "Africa."
- 5 See World Development Indicators data for employment in agriculture (% of total employment), using a modeled estimate from the International Labor Organization: <https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=ZG>.
- 6 Challinor, A.J. et al. 2014. "A Meta-Analysis of Crop Yield under Climate Change and Adaptation." *Nature Climate Change* 4 (4): 287–91. doi:10.1038/nclimate2153.
- 7 WMO. 2020. "State of the Climate in Africa 2019." WMO-No. 1253. Geneva: World Meteorological Organization. https://library.wmo.int/index.php?lvl=notice_display&id=21778#.YFfNuHvPxEa.
- 8 Woetzel, J. et al. 2020. "Climate Risk and Response: Physical Hazards and Socioeconomic Impacts." McKinsey Global Institute. <https://www.mckinsey.com/capabilities/sustainability/our-insights/climate-risk-and-response-physical-hazards-and-socioeconomic-impacts>.
- 9 Woetzel et al., 2020.
- 10 Boland, B. et al. 2022. "Climate Risk and the Opportunity for Real Estate." McKinsey & Company. <https://www.mckinsey.com/industries/real-estate/our-insights/climate-risk-and-the-opportunity-for-real-estate>.
- 11 IEA. 2020. "Climate Impacts on African Hydropower." Paris: International Energy Agency. <https://www.iea.org/reports/climate-impacts-on-african-hydropower/climate-risks-to-african-hydropower>.
- See also Box 9.5 in Trisos et al., 2022, "Africa."
- 12 McKinsey Global Institute. 2020. "Climate Risk and Response – Internal Africa."
- 13 Coldrey, K. and J. Turpie. 2019. "Climate Change Vulnerability and Adaptation Assessment for the Greater Mara Ecosystem." Prepared by Anchor Environmental Consultants. Nairobi: WWF Kenya.
- 14 Assuming an RCP 8.5 scenario of emissions.
- 15 Bouchene et al., 2021, "Green Africa: A Growth and Resilience Agenda for the Continent."
- 16 See Section 9.7 in Trisos et al., 2022, "Africa."
- See also: Woetzel, J. et al. 2020. "How Will African Farmers Adjust to Changing Patterns of Precipitation?" Case Study. McKinsey Global Institute. <https://www.mckinsey.com/capabilities/sustainability/our-insights/how-will-african-farmers-adjust-to-changing-patterns-of-precipitation>.
- Mason, N., D. Nalimalapu, and J. Corfee-Morlot. 2019. "Climate Change Is Hurting Africa's Water Sector, but Investing in Water Can Pay Off." World Resources Institute Insights (blog), October 7. <https://www.wri.org/insights/climate-change-hurting-africas-water-sector-investing-water-can-pay>.
- 17 See Box 9.5 in Trisos et al., 2022, "Africa."
- 18 CDP. 2020. "Cleaning up Their Act: Are Companies Responding to the Risks and Opportunities Posed by Water Pollution?" CDP Global Water Report 2019. London: CDP Worldwide. <https://www.cdp.net/en/research/global-reports/cleaning-up-their-act>.
- 19 McKinsey Global Institute, 2020, "Climate Risk and Response – Internal Africa."
- 20 Zyl, A. van, A. Maritz, and E. Retief. 2020. "Dealing with Climate Change." African Mining Online (blog), January 30. <https://www.africanmining.co.za/2020/01/30/dealing-with-climate-change/>.
- 21 Woetzel et al., 2020, "Climate Risk and Response: Physical Hazards and Socioeconomic Impacts."
- 22 This includes companies of different sizes across sectors, including multinationals, MSMEs and financial players.
- 23 Chan, S. et al. 2021. "The Private Sector." In State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World, 170–85. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- 24 Hallegatte, S., J. Rentschler, and J. Rozenberg. 2019. Lifelines: The Resilient Infrastructure Opportunity. Sustainable Infrastructure Series. Washington, DC: World Bank. <http://hdl.handle.net/10986/31805>.
- 25 Chan et al., 2021, "The Private Sector."
- 26 Bouchene et al., 2021, "Green Africa: A Growth and Resilience Agenda for the Continent."
- 27 Belgibayeva, A. et al. 2021. "More Risk: The Changing Nature of P&C Insurance Opportunities to 2040." *sigma* No. 4/2021. Zurich: Swiss Re Institute. <https://www.swissre.com/institute/research/sigma-research/sigma-2021-04.html>.
- 28 Bagus, U. et al. 2020. "The African Insurance Market Is Set for Take-off: Five Strategic Considerations to Help Guide Insurance Companies on Their Journey to Success in Africa." McKinsey & Company. <https://www.mckinsey.com/featured-insights/middle-east-and-africa/africas-insurance-market-is-set-for-takeoff>.
- 29 Chan et al., 2021, "The Private Sector."
- 30 Surminski, S., J. Barnes, and K. Vincent. 2019. "Insurance as a Catalyst for Using Climate Risk Information for Government Planning and Decision-Making: A Framework for Analysing Drivers and Barriers, Tested against Evidence Emerging from Sub-Saharan Africa." Working Paper. London: Centre for Climate Change Economics and Policy and Grantham Research Institute on Climate Change and the Environment. <https://www.lse.ac.uk/granthaminstitute/publication/insurance-as-a-catalyst-for-using-climate-risk-information-for-government-planning-and-decision-making/>.
- 31 Chan et al., 2021, "The Private Sector."
- 32 British International Investment. 2020. "14Trees Pioneers 3D Printing Technology in Africa for Affordable Housing and Schools." December 17. <https://www.bii.co.uk/en/news-insight/news/14trees-pioneers-3d-printing-technology-in-africa-for-affordable-housing-and-schools/>.
- 33 Hallegatte, S. 2012. "A Cost Effective Solution to Reduce Disaster Losses in Developing Countries : Hydro-Meteorological Services, Early Warning, and Evacuation." Washington, DC: World Bank. <http://hdl.handle.net/10986/9359>.
- 34 See <https://www.arc.int/about>.
- 35 Woetzel et al., 2020, "Climate Risk and Response: Physical Hazards and Socioeconomic Impacts."
- 36 WWF South Africa. 2021. "The Emerging Importance of the TCFD Framework for South African Companies and Investors." Cape Town. <https://www.wwf.org.za/?33962/TCFD-framework-importance>.
- 37 See project information and related documents on the Climatelinks hub: <https://www.climatelinks.org/content/planning-resilience-east-africa-through-policy-adaptation-research-and-economic-development>.
- 38 Gannon, K. 2020. "Supporting SMEs in Developing Countries to Adapt to Climate Change through Multi-Stakeholder Partnerships." Grantham Research Institute on Climate Change and the Environment – Commentary. June 9. <https://www.lse.ac.uk/granthaminstitute/news/supporting-smes-in-developing-countries-to-adapt-to-climate-change-through-multi-stakeholder-partnerships/>.
- 39 Chan et al., 2021, "The Private Sector."
- 40 Malabo Montpellier Panel. 2022. "Nature's Solutions: Policy Innovations and Opportunities for Africa's Bioeconomy." Kigali. <http://www.mamopanel.org/resources/bioeconomy/reports-and-briefings/natures-solutions-policy-innovations-and-opportunity/>.
- 41 Chan et al., 2021, "The Private Sector."
- 42 See <http://www.ocpafrika.com>.
- 43 The Coca-Cola Company. 2019. "The Coca-Cola System Supports Cyclone Iddai Disaster Relief Efforts in Mozambique, Zimbabwe and Malawi." Press release. March 29. <https://www.coca-colacompany.com/press-releases/coca-cola-system-supports-cyclone-iddai-disaster-relief-efforts>.
- 44 Jurd de Girancourt, F. et al. 2020. "African Banking after the Crisis: How African Banks Can Manage the Impact of COVID-19—and Prepare for Recovery." McKinsey & Company. <https://www.mckinsey.com/featured-insights/middle-east-and-africa/african-banking-after-the-crisis>.
- 45 Reid, H. et al. 2021. "Jobs." In State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World, 210–35. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- 46 Bouchene et al., 2021, "Green Africa: A Growth and Resilience Agenda for the Continent."
- 47 Chan et al., 2021, "The Private Sector."
- 48 See https://www.ilo.org/global/topics/green-jobs/projects/africa/WCMS_209922/.
- 49 Chan et al., 2021, "The Private Sector."
- 50 Bagus et al., 2020, "The African Insurance Market Is Set for Take-off: Five Strategic Considerations to Help Guide Insurance Companies on Their Journey to Success in Africa."
- 51 See <https://www.nbi.org.za/about-us/>.
- 52 Chan et al., 2021, "The Private Sector."
- 53 See the World Bank event "Climate Resilient Development in Africa: Responding to the IPCC Report on Adaptation to Climate Change," held April 27, 2022: <https://www.worldbank.org/en/events/2022/05/09/climate-resilient-development-in-africa-responding-to-the-ipcc-report-on-adaptation-to-climate-change>.
- 54 Chan et al., 2021, "The Private Sector."
- 55 Woetzel et al., 2020, "Climate Risk and Response: Physical Hazards and Socioeconomic Impacts."
- 56 Chan et al., 2021, "The Private Sector."

Technical Assistance Program (TAP)

- 1 Richmond, M. et al. 2021. "Financial Innovation for Climate Adaptation in Africa." Rotterdam: Global Center on Adaptation and Climate Policy Initiative. <https://gca.org/reports/financial-innovation-for-climate-adaptation-in-africa/>.
- 2 The ND-GAIN Country Index summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. It aims to help governments, businesses, and communities better prioritize investments for a more efficient response to the immediate global challenges ahead. A low score indicates a high degree of vulnerability. See <https://gain.nd.edu/our-work/country-index/>.
- 3 CABRI. 2021. "Budgetisation inclusive et financement de la lutte contre le changement climatique en Afrique : L'intégration du changement climatique dans la budgétisation et les finances." Compte-rendu principal. Centurion, South Africa. <https://www.cabri-sbo.org/fr/publications/inclusive-budgeting-and-financing-for-climate-change-in-africa>.
- 4 Manuamorn, O.P. and R. Biesbroek. 2020. "Do Direct-Access and Indirect-Access Adaptation Projects Differ in Their Focus on Local Communities? A Systematic Analysis of 63 Adaptation Fund Projects." *Regional Environmental Change* 20 (4): 139. doi:10.1007/s10113-020-01716-4.
- 5 Masullo, I., G. Larsen, and L. Brown. 2015. "Direct Access' to Climate Finance: Lessons Learned by National Institutions." Working Paper. Washington, DC: World Resources Institute. <https://www.wri.org/research/direct-access-climate-finance-lessons-learned-national-institutions>.
- 6 Wang, B. and N. Rai. 2015. "The Green Climate Fund Accreditation Process: Barrier or Opportunity?" IIED Briefing, September 2015. London and Dhaka: International Institute for Environment and Development and International Center for Climate Change and Development. <https://pubs.iied.org/17311iied>.
- 7 Eussner, A. et al. 2020. "Independent Synthesis of the Green Climate Fund's Accreditation Function." Evaluation Report No. 6, June 2020. Songdo, South Korea: Independent Evaluation Unit, Green Climate Fund. <https://ieu.greenclimate.fund/evaluation/accred2020>.
- 8 The general objective of the PSA is to streamline the assessment processes for accreditation and second-level due diligence (of funding proposals) into a single assessment. The PSA differs from two-step assessments currently practiced through the accreditation and proposal approval processes: it would simultaneously assess an organization's ability to implement or undertake the proposed project/program as well as the proposed project/program itself. This would broaden access to GCF for organizations for which the existing accreditation process imposes significant transaction costs not justified if their intention is to bring only a single project forward (GCF/B.20/17 – B).

Livestock

- 1 Staal, S.J. et al. 2009. "Targeting Strategic Investment in Livestock Development as a Vehicle for Rural Livelihoods." Bill and Melinda Gates Foundation – ILRI Knowledge Generation Project Report. Nairobi: International Livestock Research Institute. <https://hdl.handle.net/10568/35206>.
- 2 Baltenweck, I. et al. 2020. "Why Is Production of Animal Source Foods Important for Economic Development in Africa and Asia?" *Animal Frontiers* 10 (4): 22–29. doi:10.1093/af/vfaa036.
- 3 IFPRI. 2022. 2022 Global Food Policy Report: Climate Change and Food Systems. Washington, DC: International Food Policy Research Institute. doi:10.2499/9780896294257.
- 4 Staal et al., 2009, "Targeting Strategic Investment in Livestock Development as a Vehicle for Rural Livelihoods." See also Sheahan, M. and C.B. Barrett. 2017. "Ten Striking Facts about Agricultural Input Use in Sub-Saharan Africa." *Food Policy, Agriculture in Africa – Telling Myths from Facts*, 67 (February): 12–25. doi:10.1016/j.foodpol.2016.09.010.
- 5 Kitalyi, A. et al. 2005. "Why Keep Livestock If You Are Poor?" In *Livestock and Wealth Creation: Improving the Husbandry of Animals Kept by Resource-Poor People in Developing Countries*, edited by E. Owen et al., 13–27. Nottingham: Nottingham University Press.
- 6 Baltenweck et al., 2020, "Why Is Production of Animal Source Foods Important for Economic Development in Africa and Asia?"
- 7 Kariuki, J. et al. 2022. "Does the Gender of Farmers Matter for Improving Small Ruminant Productivity? A Kenyan Case Study." *Small Ruminant Research* 206 (January): 106574. doi:10.1016/j.smallrumres.2021.106574.
- 8 Lowder, S.K., J. Skoet, and T. Raney. 2016. "The Number, Size, and Distribution of Farms, Smallholder Farms, and Family Farms Worldwide." *World Development* 87 (November): 16–29. doi:10.1016/j.worlddev.2015.10.041.
- 9 Dixon, J. et al., eds. 2019. *Farming Systems and Food Security in Africa: Priorities for Science and Policy under Global Change*. London: Routledge <https://www.routledge.com/Farming-Systems-and-Food-Security-in-Africa-Priorities-for-Science-and-Dixon-Garrity-Boffa-Williams-Amade-Auricht-Lott-Mburathi/p/book/9781032082141>.
- 10 Robinson, T.P. et al. 2011. *Global Livestock Production Systems*. Rome: Food and Agriculture Organization of the United Nations and International Livestock Research Institute. <https://www.fao.org/publications/card/en/c/aea49989-7d6f-54a5-aaec-c12fe4ef097/>.
- 11 Dixon et al., 2019, *Farming Systems and Food Security in Africa: Priorities for Science and Policy under Global Change*.
- 12 Robinson et al., 2011, *Global Livestock Production Systems*.
- 13 Mwai, O. et al. 2015. "African Indigenous Cattle: Unique Genetic Resources in a Rapidly Changing World." *Asian-Australasian Journal of Animal Sciences* 28 (7): 911–21. doi:10.5713/ajas.15.0002R.
- 14 Dominguez-Salas, P. et al. 2019. "Contributions of Milk Production to Food and Nutrition Security." In *Encyclopedia of Food Security and Sustainability*, edited by P. Ferranti, E.M. Berry, and J.R. Anderson, 278–91. Oxford: Elsevier. doi:10.1016/B978-0-08-100596-5.21526-6.

- 15 Lee-Smith, D. and D. Lamba. 2015. "Nutrition and Urban Agriculture in Sub-Saharan African Cities." *Watch*.
- 16 Godde, C.M. et al. 2021. "Impacts of Climate Change on the Livestock Food Supply Chain; a Review of the Evidence." *Global Food Security* 28 (March): 100488. doi:10.1016/j.gfs.2020.100488.
- 17 Gerber, P.J. et al. 2013. "Tackling Climate Change through Livestock: A Global Assessment of Emissions and Mitigation Opportunities." Rome: Food and Agriculture Organization of the United Nations. http://www.fao.org/ag/againfo/resources/en/publications/tackling_climate_change/index.htm.
- 18 Collier, R.J. and K.G. Gebremedhin. 2015. "Thermal Biology of Domestic Animals." *Annual Review of Animal Biosciences* 3 (1): 513–32. doi:10.1146/annurev-animal-022114-110659.
- 19 Thornton, P.K. et al. 2021. "Increases in Extreme Heat Stress in Domesticated Livestock Species during the Twenty-first Century." *Global Change Biology* 27 (22): 5762–72. doi:10.1111/gcb.15825.
- 20 Thornton et al., 2021.
- 21 Gilbert, M. et al. 2018. "Global Distribution Data for Cattle, Buffaloes, Horses, Sheep, Goats, Pigs, Chickens and Ducks in 2010." *Scientific Data* 5 (1): 180227. doi:10.1038/sdata.2018.227.
- 22 Thornton, P.K. et al. 2022. "The Price Tag for Transforming Food Systems under Climate Change: How Transforming Food Systems under Climate Change Will Cost Trillions, but Inaction Will Cost More." *Clim-Eat Discussion Starter*. Wageningen, Netherlands. <https://hdl.handle.net/10568/119184>.
- 23 Thornton et al., 2022.
- 24 Jarvis, A. et al. 2021. "Climate-Informed Priorities for One CGIAR Regional Integrated Initiatives." CGIAR Research Program on Climate Change, Agriculture and Food Security. <https://hdl.handle.net/10568/113289>.
- 25 Jarvis et al., 2021. Methods and data sources are given in Annex 1 of that report.
- 26 Drake, B.G., M.A. González-Meler, and S.P. Long. 1997. "More Efficient Plants: A Consequence of Rising Atmospheric CO2?" *Annual Review of Plant Physiology and Plant Molecular Biology* 48 (1): 609–39. doi:10.1146/annurev-arplant.48.1.609.
- 27 Craufurd, P.Q. and T.R. Wheeler. 2009. "Climate Change and the Flowering Time of Annual Crops." *Journal of Experimental Botany* 60 (9): 2529–39. doi:10.1093/jxb/erp196.
- 28 Rojas-Downing, M.M. et al. 2017. "Climate Change and Livestock: Impacts, Adaptation, and Mitigation." *Climate Risk Management* 16 (January): 145–63. doi:10.1016/j.crm.2017.02.001.
- 29 Tubiello, F.N., J.-F. Soussana, and S.M. Howden. 2007. "Crop and Pasture Response to Climate Change." *Proceedings of the National Academy of Sciences* 104 (50). *Proceedings of the National Academy of Sciences*: 19686–90. doi:10.1073/pnas.0701728104.
- 30 Balehegn, M. et al. 2022. "Forage Conservation in Sub-Saharan Africa: Review of Experiences, Challenges, and Opportunities." *Agronomy Journal* 114 (1): 75–99. doi:10.1002/agj2.20954.
- 31 Godde, C. et al. 2019. "Climate Change and Variability Impacts on Grazing Herds: Insights from a System Dynamics Approach for Semi-Arid Australian Rangelands." *Global Change Biology* 25 (9): 3091–3109. doi:10.1111/gcb.14669.
- 32 Ericksen, P.J., P.K. Thornton, and G.C. Nelson. 2020. "Ruminant Livestock and Climate Change in the Tropics." In *The Impact of the International Livestock Research Institute*, edited by J. McIntire and D. Grace. Nairobi and Wallingford, UK: International Livestock Research Institute and CAB International. <https://hdl.handle.net/10568/110758>.
- 33 Bett, B. et al. 2017. "Effects of Climate Change on the Occurrence and Distribution of Livestock Diseases." *Preventive Veterinary Medicine* 137 (Pt B): 119–29. doi:10.1016/j.pvetmed.2016.11.019.
- 34 Thornton, P.K. et al. 2009. "The Impacts of Climate Change on Livestock and Livestock Systems in Developing Countries: A Review of What We Know and What We Need to Know." *Agricultural Systems* 101 (3): 113–27. doi:10.1016/j.agsy.2009.05.002.
- 35 CGTN Africa. 2020. "Locusts Destroy 500,000 Acres of Crops in Ethiopia, Millions of People Need Food Aid." April 14. <https://africa.cgtn.com/2020/04/14/locusts-destroy-500000-acres-of-crops-in-ethiopia-millions-of-people-need-food-aid/>.
- 36 McKune, S.L. et al. 2015. "Climate Change through a Gendered Lens: Examining Livestock Holder Food Security." *Global Food Security* 6 (October): 1–8. doi:10.1016/j.gfs.2015.05.001.
- 37 Godde et al., 2021, "Impacts of Climate Change on the Livestock Food Supply Chain; a Review of the Evidence."
- 38 See Godde et al., 2021, and Myers, S.S. et al. 2017. "Climate Change and Global Food Systems: Potential Impacts on Food Security and Undernutrition." *Annual Review of Public Health* 38 (1): 259–77. doi:10.1146/annurev-publhealth-031816-044356.
- 39 Salm, L. et al. 2021. "How Climate Change Interacts with Inequity to Affect Nutrition." *WIREs Climate Change* 12 (2). doi:10.1002/wcc.696.
- 40 For example, USAID's REGAL program in Kenya, the World Bank DRIVE initiative, etc.
- 41 Thornton, P.K. and M. Herrero. 2015. "Adapting to Climate Change in the Mixed Crop and Livestock Farming Systems in Sub-Saharan Africa." *Nature Climate Change* 5 (9): 830–36. doi:10.1038/nclimate2754.
- 42 Sakaguchi, K., A. Varughese, and G. Auld. 2017. "Climate Wars? A Systematic Review of Empirical Analyses on the Links between Climate Change and Violent Conflict." *International Studies Review* 19 (4): 622–45. doi:10.1093/isr/vix022.
- 43 Quevedo, A. et al. 2022. "Exploring the Conflict Blind Spots in Climate Adaptation Finance in the Sahel and Horn of Africa." Supporting Pastoralism and Agriculture in Recurrent and Protracted Crises (SPARC) Working Paper. <https://www.sparc-knowledge.org/resources/exploring-conflict-blind-spots-climate-adaptation-finance-sahel-and-horn-africa>.
- 44 Mach, K.J. et al. 2019. "Climate as a Risk Factor for Armed Conflict." *Nature* 571 (7764): 193–97. doi:10.1038/s41586-019-1300-6.
- 45 Boettcher, P.J. et al. 2015. "Genetic Resources and Genomics for Adaptation of Livestock to Climate Change." *Frontiers in Genetics* 5. <https://www.frontiersin.org/articles/10.3389/fgene.2014.00461>.

Livestock continued

- 45 Thornton et al., 2009. "The Impacts of Climate Change on Livestock and Livestock Systems in Developing Countries: A Review of What We Know and What We Need to Know."
- 46 Mwai et al., 2015. "African Indigenous Cattle: Unique Genetic Resources in a Rapidly Changing World."
- 47 Ortiz-Colón, G. et al. 2018. "Assessing Climate Vulnerabilities and Adaptive Strategies for Resilient Beef and Dairy Operations in the Tropics." *Climatic Change* 146 (1): 47–58. doi:10.1007/s10584-017-2110-1.
- 48 Thornton et al., 2009. "The Impacts of Climate Change on Livestock and Livestock Systems in Developing Countries: A Review of What We Know and What We Need to Know."
- 49 Marsh, J.I. et al. 2021. "Crop Breeding for a Changing Climate: Integrating Phenomics and Genomics with Bioinformatics." *Theoretical and Applied Genetics* 134 (6): 1677–90. doi:10.1007/s00122-021-03820-3.
- 50 Montagnini, F. and E. Restrepo. 2013. "Silvopastoral Systems and Climate Change Mitigation in Latin America." *Bois et Forêts Des Tropiques* 67 (January): 3–16.
- 51 Worqlul, A.W. et al. 2021. "Constraints of Small-Scale Irrigated Fodder Production and Nutrition Assessment for Livestock Feed, a Case Study in Ethiopia." *Agricultural Water Management* 254 (August): 106973. doi:10.1016/j.agwat.2021.106973.
- 52 Balehegn et al., 2022. "Forage Conservation in Sub-Saharan Africa: Review of Experiences, Challenges, and Opportunities."
- 53 Godde et al., 2021. "Impacts of Climate Change on the Livestock Food Supply Chain; a Review of the Evidence."
- 54 Bett et al., 2017. "Effects of Climate Change on the Occurrence and Distribution of Livestock Diseases."
- 55 Homewood, K. 2008. *Ecology of African Pastoralist Societies*. 1st edition. Oxford: James Currey Publishers.
- 56 Godde et al., 2021. "Impacts of Climate Change on the Livestock Food Supply Chain; a Review of the Evidence."
- 57 Boone, R.B. et al. 2018. "Climate Change Impacts on Selected Global Rangeland Ecosystem Services." *Global Change Biology* 24 (3): 1382–93. doi:10.1111/gcb.13995.
- 58 Hobbs, N.T. et al. 2008. "Fragmentation of Rangelands: Implications for Humans, Animals, and Landscapes." *Global Environmental Change, Local evidence on vulnerabilities and adaptations to global environmental change*, 18 (4): 776–85. doi:10.1016/j.gloenvcha.2008.07.011.
- 59 Robinson, L.W. et al. 2017. "Transcending Landscapes: Working Across Scales and Levels in Pastoralist Rangeland Governance." *Environmental Management* 60 (2): 185–99. doi:10.1007/s00267-017-0870-z.
- 60 For example, see the work of the Institute for Climate and Society (IRI) at Columbia University: <https://iri.columbia.edu>; the Famine Early Warning Systems Network (FEWS NET): <https://fews.net>, and the Climate Hazards Center at the University of California – Santa Barbara: <https://www.chc.ucsb.edu>.
- 61 Deichmann, U., A. Goyal, and D. Mishra. 2016. "Will Digital Technologies Transform Agriculture in Developing Countries?" *Agricultural Economics* 47 (S1): 21–33. doi:10.1111/agec.12300.
- 62 United Nations. 2021. "Agriculture Technology for Sustainable Development: Leaving No One Behind." Report of the Secretary-General. New York. <https://digitalibrary.un.org/record/3937125>.
- 63 See Accelerating Impacts of CGIAR Climate Research for Africa: <https://aicrcra.cgiar.org>, and the Livestock and Climate initiative: <https://www.cgiar.org/initiative/34-livestock-climate-and-system-resilience>.
- 64 Taye, M. et al. 2019. "Livestock Insurance Payouts and Coping Strategies of Pastoralists during Drought." ILRI Research Brief 90. Nairobi: International Livestock Research Institute. <https://hdl.handle.net/10568/101632>.
- 65 Eriksen, S. et al. 2021. "Adaptation Interventions and Their Effect on Vulnerability in Developing Countries: Help, Hindrance or Irrelevance?" *World Development* 141 (May): 105383. doi:10.1016/j.worlddev.2020.105383.
- 66 Rich, K.M. et al. 2021. "Current and Future Trade in Livestock Products." *Revue Scientifique et Technique de l'OIE* 40 (2): 395–411. doi:10.20506/rst.40.2.3232.
- 67 Brown, M.E. et al. 2017. "Do Markets and Trade Help or Hurt the Global Food System Adapt to Climate Change?" *Food Policy* 68 (April): 154–59. doi:10.1016/j.foodpol.2017.02.004.
- 68 Huyer, S. et al. 2016. "CCAFS Gender and Social Inclusion Strategy." Working Paper No. 171. Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security. <https://hdl.handle.net/10568/72900>.
- 69 Kariuki et al., 2022. "Does the Gender of Farmers Matter for Improving Small Ruminant Productivity? A Kenyan Case Study."
- 70 Galiè, A. et al. 2022. "Livestock Innovations, Social Norms, and Women's Empowerment in the Global South." *Sustainability* 14 (7): 3741. doi:10.3390/su14073741.
- 71 Tavener, K., T.A. Crane, and T. Saxena. 2021. "Breaking Even' under Intensification? Gendered Trade-offs for Women Milk Marketers in Kenya." *Rural Sociology* 86 (1): 110–38. doi:10.1111/ruso.12345.
- 72 For example, see: Karttunen, K. and I. Sisto. 2017. *How to Integrate Gender Issues in Climate-Smart Agriculture Projects*. Rome and Washington, DC: Food and Agriculture Organization of the United Nations and World Bank. <https://www.fao.org/documents/card/en/c/45d93533-c024-4a11-90ec-feeaa329b2e39/>.
- 73 Thornton, P.K. et al. 2022. "Impacts of Heat Stress on Global Cattle Production during the 21st Century: A Modelling Study." *The Lancet Planetary Health* 6 (3). Elsevier: e192–201. doi:10.1016/S2542-5196(22)00002-X.
- 74 Eschen, R. et al. 2021. "Towards Estimating the Economic Cost of Invasive Alien Species to African Crop and Livestock Production." *CABI Agriculture and Bioscience* 2 (1): 18. doi:10.1186/s43170-021-00038-7.
- 75 Bezner Kerr, R. et al. 2022. "Food, Fibre and Other Ecosystem Products." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by H.-O. Pörtner et al., 713–906. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.
- 76 Kjellstrom, T. et al. 2019. "Working on a Warmer Planet: The Effect of Heat Stress on Productivity and Decent Work." Geneva: International Labour Organization. http://www.ilo.org/global/publications/books/WCMS_711919/.
- 77 Watts, N. et al. 2018. "The Lancet Countdown on Health and Climate Change: From 25 Years of Inaction to a Global Transformation for Public Health." *The Lancet* 391 (10120). Elsevier: 581–630. doi:10.1016/S0140-6736(17)32464-9.
- 78 ARC. 2016. "The Cost of Drought in Africa." Johannesburg: African Risk Capacity. https://unfccc.int/files/cooperation_and_support/financial_mechanism/standing_committee/application/pdf/arc_cost_of_drought_en.pdf.
- 79 Orlov, A. et al. 2020. "Economic Costs of Heat-Induced Reductions in Worker Productivity Due to Global Warming." *Global Environmental Change* 63 (July): 102087. doi:10.1016/j.gloenvcha.2020.102087.
- 80 Parsons, L.A. et al. 2021. "Increased Labor Losses and Decreased Adaptation Potential in a Warmer World." *Nature Communications* 12 (1): 7286. doi:10.1038/s41467-021-27328-y.
- 81 Lissner, T., A. Thomas, and E. Theokritoff. 2022. "Doubling Adaptation Finance: A Floor Not the Ceiling of Needs." Briefing. Berlin: Climate Analytics. <https://climateanalytics.org/publications/2022/current-and-pledged-adaptation-finance/>.
- 82 Rozenberg, J. and M. Fay. 2019. *Beyond the Gap: How Countries Can Afford the Infrastructure They Need While Protecting the Planet*. Washington, DC: World Bank. <http://hdl.handle.net/10986/31291>.
- 83 UNEP. 2021. "Adaptation Gap Report 2021: The Gathering Storm – Adapting to Climate Change in a Post-Pandemic World." Nairobi: United Nations Environment Programme. <https://www.unep.org/resources/adaptation-gap-report-2021>.
- 84 PCSL (Programme for Climate-Smart Livestock Systems), 2022a. Analysis of climate finance flows for the livestock sector and related systems in Ethiopia, Kenya, Tanzania, Uganda, Eastern Africa and the Horn of Africa. ILRI, Nairobi.
- 85 SDG Knowledge Hub. 2022. "G7 Ministers Recommit to SDGs, Joint Action on Climate, Environment, Energy | News | SDG Knowledge Hub | IISD." June 2. <https://sdg.iisd.org/443/news/g7-ministers-recommit-to-sdgs-joint-action-on-climate-environment-energy/>.
- 86 Thornton et al., 2022. "The Price Tag for Transforming Food Systems under Climate Change: How Transforming Food Systems under Climate Change Will Cost Trillions, but Inaction Will Cost More."
- 87 See PCSL. 2022 (forthcoming). "Analysis of Climate Finance Flows for the Livestock Sector and Related Systems in Ethiopia, Kenya, Tanzania, Uganda, Eastern Africa and the Horn of Africa." Programme for Climate-Smart Livestock Systems. Nairobi: International Livestock Research Institute. <https://www.ilri.org/programme-for-climate-smart-livestock-systems>.
- 88 PCSL. 2022 (forthcoming). "Climate Finance Mapping in Mali and Senegal." Programme for Climate-Smart Livestock Systems. Nairobi: International Livestock Research Institute. <https://www.ilri.org/programme-for-climate-smart-livestock-systems>.
- 88 Eriksen, P. and L. Cramer. 2021. "Climate Change Is Already Hitting Africa's Livestock. Here's How COP26 Can Help." *The Conversation* (blog), October 28. <http://theconversation.com/climate-change-is-already-hitting-africas-livestock-heres-how-cop26-can-help-170726>.
- 89 Eriksen and Cramer, 2021.
- 90 Chevallier, R. 2022. "Policy Coherence Analysis in Climate-Smart Agriculture (CSA) in Africa." AICCRA Working Paper No. 2. Accelerating Impacts of CGIAR Climate Research for Africa. <https://hdl.handle.net/10568/119348>.
- 91 African Union. 2022. "African Union Climate Change and Resilient Development Strategy and Action Plan (2022–2032)." Addis Ababa. <https://au.int/en/documents/20220628/african-union-climate-change-and-resilient-development-strategy-and-action-plan>.
- 92 Simpkin, P. et al. 2020. "Current Situation and Plausible Future Scenarios for Livestock Management Systems under Climate Change in Africa." CCAFS Working Paper No. 307. Wageningen, Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security. <https://hdl.handle.net/10568/108139>.

Innovation in Agriculture

- 1 GCA. 2021. State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- 2 Bentley, Alison et al. 2022. "Another Food Crisis? The Ukraine Conflict, Global Wheat Supply and Food Security (Version V1)." Zenodo. doi:10.5281/zenodo.6380085.
- 3 FAO et al. 2020. The State of Food Security and Nutrition in the World 2020: Transforming food systems for affordable healthy diets. Rome, Italy: Food and Agriculture Organization of the United Nations, International Fund for Agricultural Development, United Nations Children's Fund, World Food Programme, and World Health Organization. doi:10.4060/ca9692en.
- 4 GCA. 2021. "Agriculture and Food Systems." In State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World, 240–99. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- 5 World Bank Group. 2015. "Future of Food: Shaping a Climate-Smart Global Food System." Working Paper. Washington, DC: World Bank. <http://hdl.handle.net/10986/22927>.
- 6 World Bank Group. 2021. "World Bank Group Climate Change Action Plan 2021–2025: Supporting Green, Resilient, and Inclusive Development." Washington, DC. <http://hdl.handle.net/10986/35799>.
- 7 FAO. 2019. "FAO and the Koronivia Joint Work on Agriculture." Rome: Food and Agriculture Organization of the United Nations. <https://www.fao.org/documents/card/en/c/ca7023en>.
- 8 FAO. 2021. Strategic Framework 2022–31. Rome: Food and Agriculture Organization of the United Nations. <https://www.fao.org/documents/card/en/c/cb7099en>.
- 9 UNFCCC. 2021. "Glasgow Climate Pact." Glasgow: United Nations Framework Convention on Climate Change. <https://unfccc.int/process-and-meetings/the-paris-agreement/the-glasgow-climate-pact-key-outcomes-from-cop26>.
- 10 UNFCCC. 2015. "Paris Agreement." FCCC/CP/2015/10/Add.1. Paris: United Nations Framework Convention on Climate Change. http://unfccc.int/paris_agreement/items/9485.php.
- 11 ARA. 2021. "Adaptation Research Alliance (ARA) Joint Statement on Launch – 9 November 2021." Glasgow: UN Climate Change Conference UK 2021. <https://ukcop26.org/adaptation-research-alliance-ara-joint-statement-on-launch-9-november-2021/>.
- 12 See <https://www.aimforclimate.org>.
- 13 See <https://www.aimforclimate.org/innovation-sprints/>.
- 14 CGIAR. 2021. "CGIAR 2030 Research and Innovation Strategy: Transforming Food, Land, and Water Systems in a Climate Crisis." Montpellier, France: CGIAR System Organization. <https://cgispace.cgiar.org/bitstream/handle/10568/110918/OneCGIAR-Strategy.pdf>.
- 15 See <https://sdgs.un.org/goals>.
- 16 See the World Bank's resource hub on CSA: <https://www.worldbank.org/en/topic/climate-smart-agriculture>.
- 17 World Bank Group, 2015, "Future of Food: Shaping a Climate-Smart Global Food System."
- 18 Smith, P. et al. 2008. "Greenhouse Gas Mitigation in Agriculture." Philosophical Transactions of the Royal Society B: Biological Sciences 363 (1492). Royal Society: 789–813. doi:10.1098/rstb.2007.2184.
- 19 See "Chapter 1: The Basics" on the Climate-Smart Agriculture 101 website created by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS): <https://csa.guide/#chapter-1>.
- 20 World Bank Group, 2021, "World Bank Group Climate Change Action Plan 2021–2025: Supporting Green, Resilient, and Inclusive Development."
- 21 Bailey-Serres, J. et al. 2019. "Genetic Strategies for Improving Crop Yields." Nature 575 (7781): 109–18. doi:10.1038/s41586-019-1679-0.
- 22 See the Broad Institute's "Questions and Answers about CRISPR": <https://www.broadinstitute.org/what-broad/areas-focus/project-spotlight/questions-and-answers-about-crispr>.
- 23 See the project page on the Foundation for Food & Agriculture Research website: <https://foundationfor.org/grants-funding/grants/fast-tracking-climate-solutions-from-global-germplasm-banks/>.
- 24 See <https://africanorphanocrops.org>.
- 25 See <https://brapi.org> and Selby, P. et al. 2019. "BrAPI—an Application Programming Interface for Plant Breeding Applications." Edited by J. Wren. Bioinformatics 35 (20): 4147–55. doi:10.1093/bioinformatics/btz190.
- 26 See <https://africanorphanocrops.org/africa-plant-breeding-academy/>.
- 27 See <https://www.nepad.org>.
- 28 See <https://excellenceinbreeding.org>.
- 29 See <http://cbsugubii05.biohpc.cornell.edu/wordpress/>.
- 30 Atanda, S.A. et al. 2021. "Maximizing Efficiency of Genomic Selection in CIMMYT's Tropical Maize Breeding Program." Theoretical and Applied Genetics 134 (1): 279–94. doi:10.1007/s00122-020-03696-9. Santantonio, N. et al. 2020. "Strategies for Effective Use of Genomic Information in Crop Breeding Programs Serving Africa and South Asia." Frontiers in Plant Science 11 (March): 353. doi:10.3389/fpls.2020.00353. MacNeil, M. 2021. "Researchers Identify Optimal Strategy to Maximize Genomic Estimated Breeding Values." International Maize and Wheat Improvement Center (CIMMYT) News, March 3. <https://www.cimmyt.org/news/researchers-identify-optimal-strategy-to-maximize-genomic-estimated-breeding-values/>.
- 31 Tully, K. et al. 2015. "The State of Soil Degradation in Sub-Saharan Africa: Baselines, Trajectories, and Solutions." Sustainability 7 (6): 6523–52. doi:10.3390/su7066523.
- 32 Winowiecki, L.A. and S. Park. 2021. "The U.N. Food Systems Summit Is Laying the Groundwork for Change – from the Soil Up." CIFOR Forests News, September 21. <https://forestsnews.cifor.org/74621/the-u-n-food-system-summit-is-laying-the-groundwork-for-change-from-the-soil-up?fnl=en>.
- 33 Bamdad, H. et al. 2022. "Soil Amendments for Sustainable Agriculture: Microbial Organic Fertilizers." Soil Use and Management 38 (1): 94–120. doi:10.1111/sum.12762.
- 34 Beggi, F. and D. Dasgupta. 2021. "Not All about Diversity: What Drives the Invisible Root-Microbiome?" Alliance of Bioversity International and CIAT (blog), September 3. <https://alliancebioversityciat.org/stories/what-drives-root-microbiome>.
- 35 Tully et al., 2015, "The State of Soil Degradation in Sub-Saharan Africa: Baselines, Trajectories, and Solutions"; Winowiecki and Park, 2021, "The U.N. Food Systems Summit Is Laying the Groundwork for Change – from the Soil Up"; Bamdad et al., 2022, "Soil Amendments for Sustainable Agriculture: Microbial Organic Fertilizers"; Beggi and Dasgupta, 2021, "Not All about Diversity: What Drives the Invisible Root-Microbiome?"
- 36 See <https://www.n2africa.org/home>.
- 37 World Bank Group, 2015, "Future of Food: Shaping a Climate-Smart Global Food System."
- 38 Oldroyd, G.E.D. and O. Leyser. 2020. "A Plant's Diet, Surviving in a Variable Nutrient Environment." Science 368 (6486): eaba0196. doi:10.1126/science.aba0196.
- 39 Nayak, H.S. et al. 2022. "Point Placement of Late Vegetative Stage Nitrogen Splits Increase the Productivity, N-Use Efficiency and Profitability of Tropical Maize under Decade Long Conservation Agriculture." European Journal of Agronomy 133 (February): 126417. doi:10.1016/j.eja.2021.126417. Mundia, M. 2021. "Brachiaria Grass, a Climate-Smart 'Wonder Grass' for Livestock Farmers." International Livestock Research Institute, February 4. <https://www.ilri.org/news/brachiaria-grass-climate-smart-%E2%80%98wonder-grass%E2%80%99-livestock-farmers-0>. Oldroyd and Leyser, 2020, "A Plant's Diet, Surviving in a Variable Nutrient Environment." Macmillan, S. 2013. "Secrets of Brachiaria: An African Pasture Grass Holds Enormous Promise for Reducing Greenhouse Gases." ILRI Clippings (blog), September 15. <https://clippings.ilri.org/2013/09/15/secrets-of-brachiaria-an-african-pasture-grass-holds-enormous-promise-for-reducing-greenhouse-gases/>.
- 40 Bamdad et al., 2022, "Soil Amendments for Sustainable Agriculture: Microbial Organic Fertilizers."
- 41 SoAR Foundation. 2020. "Developing Global Priorities for Plant Research: Adapting Agriculture to Climate Variability." Arlington, VA, US: Supporters of Agricultural Research Foundation. <https://supporttagresearch.org/our-projects/developing-global-priorities-for-plant-research-adapting-agriculture-to-climate-variability>.
- 42 Ning, Y., W. Liu, and G.-L. Wang. 2017. "Balancing Immunity and Yield in Crop Plants." Trends in Plant Science 22 (12): 1069–79. doi:10.1016/j.tplants.2017.09.010.
- 43 See the project page on the 2Blades Foundation website: <https://2blades.org/projects-and-technology/projects/1/>.
- 44 Lee, S. et al. 2022. "Broad-Spectrum Fungal Resistance in Sorghum Is Conferred through the Complex Regulation of an Immune Receptor Gene Embedded in a Natural Antisense Transcript." The Plant Cell 34 (5): 1641–65. doi:10.1093/plcell/koab305.
- 45 Bossa-Castro, A.M. et al. 2018. "Allelic Variation for Broad-Spectrum Resistance and Susceptibility to Bacterial Pathogens Identified in a Rice MAGIC Population." Plant Biotechnology Journal 16 (9): 1559–68. doi:10.1111/pbi.12895.
- 46 Ning, Y. and G.-L. Wang. 2018. "Breeding Plant Broad-Spectrum Resistance without Yield Penalties." Proceedings of the National Academy of Sciences 115 (12): 2859–61. doi:10.1073/pnas.1801235115.
- 47 Scott, M.F. et al. 2020. "Multi-Parent Populations in Crops: A Toolbox Integrating Genomics and Genetic Mapping with Breeding." Heredity 125 (6): 396–416. doi:10.1038/s41437-020-0336-6.
- 48 Verdier, V., C. Vera Cruz, and J.E. Leach. 2012. "Controlling Rice Bacterial Blight in Africa: Needs and Prospects." Journal of Biotechnology 159 (4): 320–28. doi:10.1016/j.jbiotec.2011.09.020.
- 49 Bossa-Castro et al., 2018, "Allelic Variation for Broad-Spectrum Resistance and Susceptibility to Bacterial Pathogens Identified in a Rice MAGIC Population."
- 50 Alabi, O.J., P.L. Kumar, and R.A. Naidu. 2011. "Cassava Mosaic Disease: A Curse to Food Security in Sub-Saharan Africa." APSnet Features. Washington State University and International Institute of Tropical Agriculture. <https://www.apsnet.org/edcenter/apsnetfeatures/Pages/cassava.aspx>.
- 51 See <https://www.nextgencassava.org> and: Sheat, S., X. Zhang, and S. Winter. 2022. "High-Throughput Virus Screening in Crosses of South American and African Cassava Germplasm Reveals Broad-Spectrum Resistance against Viruses Causing Cassava Brown Streak Disease and Cassava Mosaic Virus Disease." Agronomy 12 (5): 1055. doi:10.3390/agronomy12051055.
- 52 Zhang, H. et al. 2022. "The Cassava NBS-LRR Genes Confer Resistance to Cassava Bacterial Blight." Frontiers in Plant Science 13 (February): 790140. doi:10.3389/fpls.2022.790140.
- 53 Ogbonna, A.C. et al. 2021. "A Population Based Expression Atlas Provides Insights into Disease Resistance and Other Physiological Traits in Cassava (Manihot Esculenta Crantz)." Scientific Reports 11 (1): 23520. doi:10.1038/s41598-021-02794-y.
- 54 See <https://nrcri.gov.ng>.
- 55 Kumar, A. et al. 2021. "Transgenic Cowpea Plants Expressing Bacillus Thuringiensis Cry2Aa Insecticidal Protein Imparts Resistance to Maruca Vitrata Legume Pod Borer." Plant Cell Reports 40 (3): 583–94. doi:10.1007/s00299-020-02657-2.
- 56 Bernard, G.C., M. Egnin, and C. Bonsi. 2017. "The Impact of Plant-Parasitic Nematodes on Agriculture and Methods of Control." In Nematology: Concepts, Diagnosis and Control, edited by M.M. Shah and M. Mahamood. London: InTech. doi:10.5772/intechopen.68958.
- 57 Manohar, M. et al. 2020. "Plant Metabolism of Nematode Pheromones Mediates Plant-Nematode Interactions." Nature Communications 11 (1): 208. doi:10.1038/s41467-019-14104-2.
- 58 Scholes, J.D. and M.C. Press, 2008. Striga infestation of cereal crops—an unsolved problem in resource limited agriculture. Curr. Opin. Plant Biol., 11: 180-186.
- 59 Ronald, M. et al. 2017. "Predictions of the Striga Scourge under New Climate in Southern Africa: A Perspective." Journal of Biological Sciences 17 (5): 194–201. doi:10.3923/jbs.2017.194.201.
- 60 Rodenburg, J. et al. 2016. "Parasitic Weed Incidence and Related Economic Losses in Rice in Africa." Agriculture, Ecosystems & Environment 235 (November): 306–17. doi:10.1016/j.agee.2016.10.020.

Innovation in Agriculture

continued

- 61 Ghanim, A.M.A. 2022. "CRP Success Story: Mutation Breeding for Resistance to Striga Parasitic Weed in Cereals for Food Security (D25005)." International Atomic Energy Agency News, March 18. <https://www.iaea.org/newscenter/news/crp-success-story-mutation-breeding-for-resistance-to-striga-parasitic-weed-in-cereals-for-food-security-d25005>.
- 62 Ronald et al., 2017, "Predictions of the Striga Scourge under New Climate in Southern Africa: A Perspective."
- 63 Musango, R. et al. 2022. "Alectra Vogelii: A Threat to Bambara Groundnut Production under Climate Change: A Review Paper." Journal of Agricultural Chemistry and Environment 11 (02): 83–105. doi:10.4236/jacen.2022.112006.
- 64 Scott, D. et al. 2020. "Mapping the Drivers of Parasitic Weed Abundance at a National Scale: A New Approach Applied to Striga Asiatica in the Mid-west of Madagascar." Weed Research 60 (5): 323–33. doi:10.1111/wre.12436. Mudereri, B.T. et al. 2020. "Multi-Source Spatial Data-Based Invasion Risk Modeling of Striga (Striga Asiatica) in Zimbabwe." GIScience & Remote Sensing 57 (4): 553–71. doi:10.1080/15481603.2020.1744250.
- 65 Ramesh, K. et al. 2017. "Weeds in a Changing Climate: Vulnerabilities, Consequences, and Implications for Future Weed Management." Frontiers in Plant Science 8 (February). doi:10.3389/fpls.2017.00095. Rafferty, N.E., L. Agnew, and P.D. Naby. 2019. "Parasitism Modifies the Direct Effects of Warming on a Hemiparasite and Its Host." Edited by I. Ibáñez. PLOS ONE 14 (10): e0224482. doi:10.1371/journal.pone.0224482.
- 66 Mbuvu, D.A. et al. 2017. "Novel Sources of Witchweed (Striga) Resistance from Wild Sorghum Accessions." Frontiers in Plant Science 8 (February). doi:10.3389/fpls.2017.00116.
- 67 Rubiales, D. et al. 2018. "Editorial: Advances in Parasitic Weed Research." Frontiers in Plant Science 9 (March): 236. doi:10.3389/fpls.2018.00236.
- 68 Ghanim, A.M.A. 2022. "CRP Success Story: Mutation Breeding for Resistance to Striga Parasitic Weed in Cereals for Food Security (D25005)." International Atomic Energy Agency News, March 18. <https://www.iaea.org/newscenter/news/crp-success-story-mutation-breeding-for-resistance-to-striga-parasitic-weed-in-cereals-for-food-security-d25005>.
- 69 Tsuchiya, Y., M. Yoshimura, and S. Hagihara. 2018. "The Dynamics of Strigolactone Perception in Striga Hermonthica: A Working Hypothesis." Journal of Experimental Botany 69 (9): 2281–90. doi:10.1093/jxb/ery061.
- 70 See <https://www.itbm.nagoya-u.ac.jp/>.
- 71 Tsuchiya, Y. 2018. "Small Molecule Toolbox for Strigolactone Biology." Plant and Cell Physiology 59 (8): 1511–19. doi:10.1093/pccp/pcy119. Uruguchi, D. et al. 2018. "A Femtomolar-Range Suicide Germination Stimulant for the Parasitic Plant Striga Hermonthica." Science 362 (6420): 1301–5. doi:10.1126/science.aau5445.
- 72 Trisos, C.H. et al. 2022. "Africa." In Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by H.-O. Pörtner et al., 1285–1455. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.
- 73 Branca, G. et al. 2012. Identifying Opportunities for Climate-Smart Agriculture Investments in Africa. Rome: Food and Agriculture Organization of the United Nations. <https://www.fao.org/documents/card/en/c/8319e40c-5c43-5a83-9778-3fd9bdc7edd7/>.
- 74 FAO. 2017. "Climate-Smart Crop Production." Climate Smart Agriculture Sourcebook. Rome: Food and Agriculture Organization of the United Nations. <https://www.fao.org/climate-smart-agriculture-sourcebook/production-resources/module-b1-crops/b1-overview/en/>.
- 75 See overview on the FAO website: <https://www.fao.org/sustainable-agricultural-mechanization/strategies/save-and-grow/>.
- 76 See <https://ilci.cornell.edu>.
- 77 See <https://www.cgiar.org/research/action-areas/>.
- 78 See project page on the CIMMYT website: <https://www.cimmyt.org/projects/avisa/>.
- 79 See description on the CGIAR website: <https://www.cgiar.org/initiative/23-climber-building-systemic-resilience-against-climate-variability-and-extremes/>.
- 80 World Bank. 2022. "Moving Towards Sustainability: The Livestock Sector and the World Bank." Brief. Washington, DC: World Bank. <https://www.worldbank.org/en/topic/agriculture/brief/moving-towards-sustainability-the-livestock-sector-and-the-world-bank>.
- 81 Macmillan, S. 2013. "Secrets of Brachiaria: An African Pasture Grass Holds Enormous Promise for Reducing Greenhouse Gases." ILRI Clippings (blog), September 15. <https://clippings.ilri.org/2013/09/15/secrets-of-brachiaria-an-african-pasture-grass-holds-enormous-promise-for-reducing-greenhouse-gases/>.
- 82 Mundia, M. 2021. "Brachiaria Grass, a Climate-Smart 'Wonder Grass' for Livestock Farmers." International Livestock Research Institute, February 4. <https://www.ilri.org/news/brachiaria-grass-climate-smart-%E2%80%98wonder-grass%E2%80%99-livestock-farmers-0>.
- 83 KDHI Agriculture. 2021. "An Overview of AI Technologies in African Agriculture." June 16. <https://www.kdhi-agriculture.com/single-post/an-overview-of-ai-technologies-in-african-agriculture>.
- 84 Kudama, G. et al. 2021. "Will Digital Solution Transform Sub-Saharan African Agriculture?" Artificial Intelligence in Agriculture 5: 292–300. doi:10.1016/j.aiaa.2021.12.001.
- 85 FAO and ITU. 2022. Status of Digital Agriculture in 47 Sub-Saharan African Countries. Rome: Food and Agriculture Organization of the United Nations and International Telecommunication Union. doi:10.4060/cb7943en.
- 86 Kuhlger, S. et al. 2016. "MultispeQ Beta: A Tool for Large-Scale Plant Phenotyping Connected to the Open PhotosynQ Network." Royal Society Open Science 3 (10): 160592. doi:10.1098/rsos.160592.
- 87 FAO and ITU, 2022, Status of Digital Agriculture in 47 Sub-Saharan African Countries.
- 88 Farmers Review Africa. 2022. "Sensor-to-Satellite Technology Delivers Global Connectivity Smart Agriculture." March 22. <https://farmersreviewafrica.com/sensor-to-satellite-technology-delivers-global-connectivity-for-smart-agriculture/>.
- 89 Jellason, N.P., E.J.Z. Robinson, and C.C. Ogbaga. 2021. "Agriculture 4.0: Is Sub-Saharan Africa Ready?" Applied Sciences 11 (12): 5750. doi:10.3390/app11125750.
- 90 Tsan, M. et al. 2019. "The Digitalisation of African Agriculture Report 2018-2019." Wageningen, Netherlands: CTA / Dalberg Advisors. <https://hdl.handle.net/10568/101498>.
- 91 Bhalla, N. 2021. "Africa's Farmers Click with Digital Tools to Boost Crops." Reuters, October 14, sec. Consumer Financial Services. <https://www.reuters.com/article/africa-tech-farming-idUSL4N2QU29J>.
- 92 See <https://aagwa.org/about>.
- 93 Langat, W. 2021. "Kenyan Farmers Tap Apps to Ride out COVID-19 and Climate Storm." Reuters, June 30. <https://www.reuters.com/article/kenya-climate-farming-tech-idUSL5N2042N9>.
- 94 See <https://farmerline.co>.
- 95 See <https://www.safaricom.co.ke/faqs/faq/810>.
- 96 See <https://akilimo.org>.
- 97 Tsan et al., 2019, "The Digitalisation of African Agriculture Report 2018-2019."
- 98 See World Bank Global Electrification Database data for access to electricity (% of population): <https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=ZG>.
- 99 Neno, S. 2020. "PlantVillage Nuru." CGIAR Platform for Big Data in Agriculture, June 7. https://bigdata.cgiar.org/divi_overlay/plantvillage-nuru/.
- 100 CubicA won the 2018 Inspire Challenge; see the profile on the CGIAR Platform for Big Data in Agriculture: <https://bigdata.cgiar.org/inspire/inspire-challenge-2018/cubica-the-new-farmer-advisory-app/>.
- 101 Maduka, E. 2021. "Focus on Africa: Climate Smart Irrigation Solutions for Smallholder Farmers." Food and Farming Technology, November 4. <https://www.foodandfarmingtechnology.com/features/focus-on-africa-climate-smart-irrigation-solutions-for-smallholder-farmers.html>.
- 102 See <https://supplant.me>.
- 103 See <https://sunculture.com>.
- 104 Branca et al., 2012, Identifying Opportunities for Climate-Smart Agriculture Investments in Africa.
- 105 See profile on the CGIAR Platform for Big Data in Agriculture: <https://bigdata.cgiar.org/inspire/inspire-challenge-2017/pest-and-disease-monitoring-by-using-artificial-intelligence/>.
- 106 See <https://hellotractor.com/tag/hello-tractor-app/>.
- 107 See <http://africasoils.net/about/partnership/>.
- 108 See <http://agriculture.columbia.edu>.
- 109 See <http://ciesin.org>.
- 110 See <https://www.ifpri.org>.
- 111 See <https://www.isric.org>.
- 112 See <https://www.rothamsted.ac.uk>.
- 113 Oliveira-Jr, A. et al. 2020. "IoT Sensing Platform as a Driver for Digital Farming in Rural Africa." Sensors 20 (12): 3511. doi:10.3390/s20123511.
- 114 Filho, T. et al. 2021. "A Standard-Based Internet of Things Platform and Data Flow Modeling for Smart Environmental Monitoring." Sensors 21 (12): 4228. doi:10.3390/s21124228.
- 115 Ramalingam, B. et al. 2020. "Remote Insects Trap Monitoring System Using Deep Learning Framework and IoT." Sensors 20 (18): 5280. doi:10.3390/s20185280.
- 116 See <http://www.thirdyewater.com>.
- 117 FutureWater. 2016. "Details ThirdEye Project." Wageningen, Netherlands. <https://www.futurewater.nl/wp-content/uploads/2016/06/DescriptionThirdEyeTechnology.pdf>.
- 118 See <https://www.zenvus.com>.
- 119 See <https://agrocenta.com>.
- 120 See <https://www.data4sdgs.org/partner/global-open-data-agriculture-and-nutrition>.
- 121 Branca et al., 2012, Identifying Opportunities for Climate-Smart Agriculture Investments in Africa.
- 122 See <https://www.biodiversityinternational.org/seeds-for-needs/>.
- 123 Kuhlger et al., 2016, "MultispeQ Beta: A Tool for Large-Scale Plant Phenotyping Connected to the Open PhotosynQ Network."
- 124 See the CCAFS overview of research on policies and priorities for CSA: <https://ccafs.cgiar.org/research/enabling-policy-environments-csa>.
- 125 See the CCAFS overview of research on climate-smart technologies and practices: <https://ccafs.cgiar.org/research/business-models-incentives-and-innovative-finance-scaling-csa>.
- 126 See the CCAFS overview of research on climate services and safety nets: <https://ccafs.cgiar.org/research/climate-services-and-safety-nets>.

Urban Informality

- 1 Gross national income per capita in Sub-Saharan Africa (Atlas method, current US\$) was just US\$1,578 in 2021, compared with a global average of US\$12,070. North African countries' incomes are significantly higher, but still low enough that, except for Libya, all are still classified as lower-middle-income countries. See World Bank data: <https://data.worldbank.org/indicator/NY.GNP.PCAP.CD?locations=ZG-ZQ-1W>.
- 2 Africa's urban population grew by an average of 3.58 percent per year in 2015–2020, compared with 2.16 percent in Asia and 1.90 percent globally. In 2021–2025, it is projected to grow by 3.44 percent per year, compared with 1.84 percent in Asia and 1.73 percent globally. UN DESA. 2018. "World Urbanization Prospects 2018." New York: United Nations Department of Economic and Social Affairs, Population Division. <http://esa.un.org/unpd/wup/>. Custom data acquired via website.
- 3 Gollin, D., M. Kirchberger, and D. Lagakos. 2021. "Do Urban Wage Premia Reflect Lower Amenities? Evidence from Africa." *Journal of Urban Economics* 121 (January): 103301. doi:10.1016/j.jue.2020.103301.go
- 4 Stecklov, G. and A. Menashe-Oren. 2019. "The Demography of Rural Youth in Developing Countries." IFAD Research Series, Issue 41. Rome: International Fund for Agricultural Development. <https://www.ifad.org/en/web/knowledge/-/publication/research-series-issue-41-the-demography-of-rural-youth-in-developing-countries>.
- 5 ILO. 2018. Women and Men in the Informal Economy: A Statistical Picture. 3rd ed. Geneva: International Labour Organization. http://www.ilo.org/global/publications/books/WCMS_626831/.
- 6 Trisos, C.H. et al. 2022. "Africa." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by H.-O. Pörtner et al., 1285–1455. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.
- 7 WMO. 2021. WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970–2019). Geneva: World Meteorological Organization. https://library.wmo.int/index.php?lvl=notice_display&id=21930.
- 8 See overview and a collection of reports on PreventionWeb: <https://www.preventionweb.net/collections/cyclones-idai-and-kenneth-2019>.
- 9 See overview from the UN Office for the Coordination of Humanitarian Affairs (OCHA): <https://reliefweb.int/disaster/fl-2022-000201-zaf>.
- 10 See overview from OCHA: <https://reliefweb.int/disaster/fl-2015-000065-gha>.
- 11 World Bank. 2017. "Sierra Leone – Rapid Damage and Loss Assessment of August 14th, 2017 Landslides and Floods in the Western Area." Washington, DC: World Bank. <https://documents.worldbank.org/en/publication/documents/reports/documentdetail/523671510297364577/Sierra-Leone-Rapid-damage-and-loss-assessment-of-August-14th-2017-landslides-and-floods-in-the-western-area>.
- 12 OCHA. 2022. "West and Central Africa: Flooding Situation – Overview." As of 16 August 2022. United Nations Office for the Coordination of Humanitarian Affairs. <https://reliefweb.int/report/congo/west-and-central-africa-flooding-situation-16-august-2022>.
- 13 Millington, N. and S. Scheba. 2021. "Day Zero and The Infrastructures of Climate Change: Water Governance, Inequality, and Infrastructural Politics in Cape Town's Water Crisis." *International Journal of Urban and Regional Research* 45 (1): 116–32. doi:<https://doi.org/10.1111/1468-2427.12899>.
- 14 This is distinct from informal employment, which includes employees (people who work for a wage for someone who is not a member of their family) who, through legal or illegal means, are not subject to national labor legislation, income taxation, social protection, or entitled to certain employment benefits (e.g. advance notice of dismissal, severance pay, paid annual or sick leave). These employees may work in the formal sector, in households, or in informal businesses, although the latter group is a very small share of employers—about 5 percent in Africa as of 2016. The sum of workers in the informal sector and informal employees is defined as employment in the informal economy. See ILO, 2018, Women and Men in the Informal Economy: A Statistical Picture.
- 15 Fox, L. and L. Signé. 2022. From Subsistence to Disruptive Innovation: Africa, The Fourth Industrial Revolution, and the Future of Jobs. Brookings Institution, Washington DC. <https://www.africaportal.org/publications/subsistence-disruptive-innovation-africa-fourth-industrial-revolution-and-future-jobs/>
- 16 Gollin, D., R. Jedwab, and D. Vollrath. 2016. "Urbanization with and without Industrialization." *Journal of Economic Growth* 21 (1): 35–70. doi:10.1007/s10887-015-9121-4.
- 17 Gollin, Jedwab, and Vollrath, 2016, "Urbanization with and without Industrialization."
- 18 Rodrik, D. 2018. "New Technologies, Global Value Chains, and Developing Economies." NBER Working Paper No. 25164, background paper written for the Pathways for Prosperity Commission. Cambridge, MA, US: National Bureau of Economic Research. doi:10.3386/w25164.
- 19 See UN-Habitat metadata for Sustainable Development Goal 11, Target 11.1: <https://unstats.un.org/sdgs/metadata/files/Metadata-11-01-01.pdf>.
- 20 See UN-Habitat data: <https://data.unhabitat.org/datasets/proportion-of-urban-population-living-in-slum-households-by-country-or-area-1990-2018-percent/explore>. This is by far the largest share for any major world region; the second-highest is Central and Southern Asia, at 31.2 percent. The global average as of 2018 was 24 percent.
- 21 Duranton, G. and A.J. Venables. 2021. "Place-Based Policies: Principles and Developing Country Applications." In *Handbook of Regional Science*, edited by M.M. Fischer and P. Nijkamp, 1009–30. Berlin, Heidelberg: Springer. doi:10.1007/978-3-662-60723-7_142.
- 22 Chen, M., S. Roever, and C. Skinner. 2016. "Editorial: Urban Livelihoods: Reframing Theory and Policy." *Environment and Urbanization* 28 (2): 331–42. doi:10.1177/0956247816662405.
- 23 Chen, Roever, and Skinner, 2016, "Editorial: Urban Livelihoods: Reframing Theory and Policy."
- 24 La Porta, R. and A. Shleifer. 2014. "Informality and Development." *Journal of Economic Perspectives* 28 (3): 109–26. doi:10.1257/jep.28.3.109.
- 25 Fox, L. and U. Kaul. 2018. "The Evidence Is In: How Should Youth Employment Programs in Low-Income Countries Be Designed?" Policy Research Working Paper No. 8500. Washington, DC: World Bank. doi:10.1596/1813-9450-8500.
- 26 Duranton and Venables, 2021, "Place-Based Policies: Principles and Developing Country Applications."
- 27 Anim, D.O., E. Gaisie, and A.B. Asare-Ansah. 2021. "Towards Sustainable and Resilient Urban Development: Rethinking Stormwater Management in Sub-Saharan African Cities." In *Sustainable Urban Futures in Africa*. Routledge. <https://www.taylorfrancis.com/chapters/edit/10.4324/9781003181484-6/>.
- 28 Scott, A.A. et al. 2017. "Temperature and Heat in Informal Settlements in Nairobi." *PLOS ONE* 12 (11): e0187300. doi:10.1371/journal.pone.0187300.
- 29 Neumann, B. et al. 2015. "Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding - A Global Assessment." *PLOS ONE* 10 (3): e0118571. doi:10.1371/journal.pone.0118571.
- 30 WMO. 2022. State of the Climate in Africa 2021. Geneva: World Meteorological Organization. https://library.wmo.int/index.php?lvl=notice_display&id=22125.
- 31 Resnick, D., E. Spencer, and T. Siwale. 2020. "Informal Traders and COVID-19 in Africa: An Opportunity to Strengthen the Social Contract." IGC Policy Brief. London: International Growth Centre. <https://www.theigc.org/publication/informal-traders-and-covid-19-in-africa-an-opportunity-to-strengthen-the-social-contract/>.
- 32 Harrington, L. and F. Otto. 2020. "Extreme Heat Is a Threat to Lives in Africa, but It's Not Being Monitored." *The Conversation* (blog), November 26. <http://theconversation.com/extreme-heat-is-a-threat-to-lives-in-africa-but-its-not-being-monitored-149921>.
- 33 Selormey, E. M. Zupork Dome, L. Osse Essima, and C. Logan. 2019. "Change ahead: Experience and awareness of climate change in Africa." *Afrobarometer Policy Paper* 60. Available at: <https://www.afrobarometer.org/publication/pp60-change-ahead-experience-and-awareness-climate-change-africa>
- 34 Calculated from Round 7 Afrobarometer data, which is available at: <https://www.afrobarometer.org/survey-resource/merged-round-7-data-34-countries-2019/>.
- 35 Ajibade, I. and G. McBean. 2014. "Climate Extremes and Housing Rights: A Political Ecology of Impacts, Early Warning and Adaptation Constraints in Lagos Slum Communities." *Geoforum* 55 (August): 76–86. doi:10.1016/j.geoforum.2014.05.005.
- 36 UN DESA, 2018, "World Urbanization Prospects 2018."
- 37 Diao, X. and P. Hazell. 2019. "Ghana's Economy-Wide Transformation: Past Patterns and Future Prospects." In *Ghana's Economic and Agricultural Transformation: Past Performance and Future Prospects*, edited by X. Diao et al., 19–48. Oxford, UK: Oxford University Press. doi:10.1093/oso/9780198845348.003.0002.
- 38 Paller, J.W. 2019. *Democracy in Ghana: Everyday Politics in Urban Africa*. Cambridge, UK, and New York: Cambridge University Press. doi:10.1017/9781108578721.
- 39 Whitfield, L. et al. 2015. *The Politics of African Industrial Policy: A Comparative Perspective*. Cambridge, UK, and New York: Cambridge University Press. doi:10.1017/CBO9781316225509.
- 40 Disasters in EM-DAT are defined according to whether 10 or more people died, 100 or more people were affected, there was a declaration of a state of emergency, or a call for international assistance.
- 41 Abass, K. et al. 2022. "Rising Incidence and Risks of Floods in Urban Ghana: Is Climate Change to Blame?" *Cities* 121 (February): 103495. doi:10.1016/j.cities.2021.103495.
- 42 MMDAs can be urban or rural. Districts comprise mostly rural areas (villages and towns). The term "Assembly" refers to the local administrative structure; the local legislative body consists of district representatives elected locally who meet in a body also called an assembly.
- 43 There were 10 sub-metros in 2017, but in 2019, seven were elevated to be their own municipal assemblies.
- 44 Focus group discussion with Adabraka Odawna Market Women and Traders Association, Korle Klotey Municipal Assembly in GAMA, September 2022.
- 45 Adamtey, R., G. Adjei-Kumi, and C.Y. Oduro. 2018. "A Research into Slums and Informal Settlements: Development towards Making Ghana's Cities Resilient." *Accra: Good Governance Africa*. <https://gga.org/research-into-slums-and-informal-settlements-development-towards-making-ghanas-cities-resilient/>.
- 46 Erman, A. et al. 2020. "The Road to Recovery the Role of Poverty in the Exposure, Vulnerability and Resilience to Floods in Accra." *Economics of Disasters and Climate Change* 4 (1): 171–93. doi:10.1007/s41885-019-00056-w.
- 47 The labor force includes youth ages 15–24 who may be combining school with work.
- 48 The data used here, from the 2017 Ghana Living Standard Survey, do not include information on tenure security. See <https://www2.statsghana.gov.gh/nada/index.php/catalog/97>.
- 49 Stacey, P. 2019. "You Can Have It For God": Mosque Building and the Production of Informal Citizenship And Property in Urban Africa." *Built Environment* 44 (4): 461–76. doi:10.2148/benv.44.4.461.
- 50 Gillespie, T. 2020. "The Real Estate Frontier." *International Journal of Urban and Regional Research* 44 (4): 599–616. doi:10.1111/1468-2427.12900. See also Gillespie, T. 2018. "Collective Self-Help, Financial Inclusion, and the Commons: Searching for Solutions to Accra's Housing Crisis." *Housing Policy Debate* 28 (1): 64–78. doi:10.1080/10511482.2017.1324892.
- 51 Oppong, B.E., R. Asomani-Boateng, and R.J. Fricano. 2020. "Accra's Old Fadama/Agbogbloshie Settlement. To What Extent Is This Slum Sustainable?" *African Geographical Review* 39 (4): 289–307. doi:10.1080/19376812.2020.1720753.
- 52 Paller, J. 2015. "Informal Networks and Access to Power to Obtain Housing in Urban Slums in Ghana." *Africa Today* 62 (October): 31–55. doi:10.2979/africatoday.62.1.31.
- 53 Gillespie, T. 2016. "Accumulation by urban dispossession: struggles over urban space in Accra, Ghana." *Transactions* 41(1): 66–77.
- 54 Holland, A.C. 2017. *Forbearance as Redistribution: The Politics of Informal Welfare in Latin America*. Cambridge Studies in Comparative Politics. Cambridge: Cambridge University Press. doi:10.1017/9781316795613.
- 55 Resnick, D. 2019. "The Politics of Crackdowns on Africa's Informal Vendors." *Comparative Politics* 52 (1): 21–51. doi:10.5129/001041519X15615651139961.
- 56 Resnick, 2019. "The Politics of Crackdowns on Africa's Informal Vendors."

Urban Informality

continued

- 57 Abass et al., 2022, "Rising Incidence and Risks of Floods in Urban Ghana: Is Climate Change to Blame?"
- 58 Okuru, M. and D. Armah-Attoh. 2015. "Ghana's Decentralization: Locally Centralized Decision Making Ill Serves Its Public." Afrobarometer Dispatch No. 23. Accra: Center for Democratic Development in Ghana. <https://www.afrobarometer.org/publication/ad23-ghanas-decentralization-locally-centralized-decision-making-ill-serves-its-public/>.
- 59 See <https://resilientcitiesnetwork.org/acpra/>.
- 60 Government of Ghana. 2018. "Ghana's National Adaptation Plan Framework." Led by the Environmental Protection Agency (EPA) in partnership with the National Development Planning Commission and the Ministry of Finance. Accra. <https://napglobalnetwork.org/resource/ghana-nap-framework/>.
- 61 Focus group discussion with Council of Chiefs at Old Fadama Informal Housing Neighborhood Association, AMA, September 2022.

City Resilience

- 1 The ND-GAIN Country Index is composed of two key dimensions of adaptation: (a) vulnerability and (b) readiness. Vulnerability is measured by a country's exposure, sensitivity, and capacity to adapt to the negative effects of climate change. ND-GAIN measures overall vulnerability by considering six life-supporting sectors—food, water, health, ecosystem services, human habitat, and infrastructure. Readiness is measured by a country's ability to leverage investments and convert them to adaptation actions. ND-GAIN measures overall readiness by considering three components—economic readiness, governance readiness, and social readiness. See <https://gain.nd.edu/our-work/country-index/>.
- 2 The Germanwatch Climate Risk Index 2021 analyzes and ranks the extent to which countries and regions have been affected by impacts of climate-related extreme weather events (storms, floods, heatwaves, etc.). See Eckstein, D., V. Künzel, and L. Schäfer. 2021. "Global Climate Risk Index 2021: Who Suffers Most From Extreme Weather Events? Weather-Related Loss Events in 2019 and 2000–2019." Briefing Paper. Bonn: Germanwatch. <https://www.germanwatch.org/en/19777>.
- 3 Verisk Maplecroft. 2018. "Urbanisation and Climate Change Risks." November 21. <https://www.maplecroft.com/insights/analysis/84-of-worlds-fastest-growing-cities-face-extreme-climate-change-risks/>.
- 4 Mbaye, A.A. 2020. "Confronting the Challenges of Climate Change on Africa's Coastal Areas." In *Foresight Africa: Top Priorities for the Continent 2020–2030*, 52–56. Viewpoint in Chapter 4 – "Combating climate change: An urgent call for comprehensive global and local action." Washington, DC: Brookings Institution. <https://www.brookings.edu/blog/africa-in-focus/2020/01/16/confronting-the-challenges-of-climate-change-on-africas-coastal-areas/>.
- 5 Eckstein, Künzel, and Schäfer, 2021, "Global Climate Risk Index 2021: Who Suffers Most From Extreme Weather Events? Weather-Related Loss Events in 2019 and 2000–2019." This is significant when compared with the most affected countries over a 20-year period (2000–2019), when Mozambique was the only African country in the top 10, at No. 5.
- 6 UN-Habitat. <https://unhabitat.org/the-new-climate-reality-protecting-african-cities-from-disaster>.
- 7 Common climate hazards include floods, droughts, storms, and fires. Risk management of these hazards will encompass the full cycle of (a) prevention, (b) mitigation, (c) protection, (d) emergency response, and (e) recovery.
- 8 This will include elements related to erosion protection in coastal areas, along water bodies, and in upstream catchments.
- 9 It is anticipated that such efforts will include not only strengthening the sharing of benefits of ecosystem services, but also enhancing community livelihoods through improved food security, access to land, etc.
- 10 These urban services will be contextualized with considerations for drainage and stormwater management.
- 11 UN DESA. 2018. "The World's Cities in 2018 – Data Booklet." (ST/ESA/SER.A/417. New York: UN Department of Economic and Social Affairs, Population Division. <http://digitallibrary.un.org/record/3799524>.
- 12 World Bank. 2020. "Madagascar Economic Update, December 2020: Setting a Course for Recovery." Washington, DC: World Bank. <http://hdl.handle.net/10986/34935>.
- 13 CIF. 2017. "First Joint Programming Mission: Support Madagascar towards Developing Its Strategic Program for Climate Resilience under the Pilot Program for Climate Resilience (PPCR), May 2–10, 2017." Washington, DC: Climate Investment Funds. https://www.climateinvestmentfunds.org/sites/default/files/meeting-documents/ppcr_madagascar_first_joint_mission_may_2-10_2017_-_tor_0.pdf.

Nature-based Solutions in Agroforestry

- 1 Rappocciolo, F. 2022. "From Gabon to Egypt: GCA at Africa Climate Week to Advance an Adaptation Breakthrough for Africa at COP27." Global Center on Adaptation. September 21. <https://gca.org/from-gabon-to-egypt-gca-at-africa-climate-week-to-advance-an-adaptation-breakthrough-for-africa-at-cop27/>.
- 2 Searchinger, T. et al. 2019. *Creating a Sustainable Food Future: A Menu of Solutions to Feed Nearly 10 Billion People by 2050*. World Resources Report, Final Report. Washington, DC: World Resources Institute. <https://research.wri.org/wrr-food>.
- 3 UN DESA. 2018. "World Urbanization Prospects 2018." New York: United Nations Department of Economic and Social Affairs, Population Division. <http://esa.un.org/unpd/wup/>. Custom data acquired via website. For Africa as a whole, UN DESA estimates that 55.6 percent of the population is rural as of 2022. However, there are large variations across countries and regions; for example, only 34.4 percent of people in Southern Africa live in rural areas, but in Eastern Africa, the share is 70.0 percent.
- 4 Cohen-Shacham, E. et al., eds. 2016. *Nature-Based Solutions to Address Global Societal Challenges*. Gland, Switzerland: International Union for the Conservation of Nature. doi:10.2305/IUCN.CH.2016.13.en (p. xii).
- 5 Seddon, N. et al. 2020. "Understanding the Value and Limits of Nature-Based Solutions to Climate Change and Other Global Challenges." *Philosophical Transactions of the Royal Society B: Biological Sciences* 375 (1794): 20190120. doi:10.1098/rstb.2019.0120.
- 6 Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being: Synthesis*. Washington, DC: Island Press. <https://www.millenniumassessment.org/documents/document.356.aspx.pdf>.
- 7 IPBES. 2019. "Global Assessment Report on Biodiversity and Ecosystem Services: Summary for Policymakers." Bonn: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. doi:10.5281/ZENODO.3553579.
- 8 UNEP. 2021. "Guidelines for Integrating Ecosystem-Based Adaptation into National Adaptation Plans: Supplement to the UNFCCC NAP Technical Guidelines." Nairobi: United Nations Environment Programme. <https://unfccc.int/documents/461132>.
- 9 CBD Secretariat. 2009. "Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change." Technical Series No. 41. Montreal: Secretariat of the Convention on Biological Diversity. <https://www.cbd.int/doc/publications/cbd-ts-41-en.pdf>.
- 10 Randrup T.B., A. Buijs, C.C. Konijnendijk and T. Wild. 2020. "Moving beyond the nature-based solutions discourse: introducing nature-based thinking." *Urban Ecosystems* 23:919–926.
- 11 MacKinnon, K., C. Sobrevilla, and V. Hickey. 2008. "Biodiversity, Climate Change, and Adaptation: Nature-Based Solutions from the World Bank Portfolio." Washington, DC: World Bank. <http://hdl.handle.net/10986/6216>.
- 12 IUCN. 2020. *IUCN Global Standard for Nature-Based Solutions: A User-Friendly Framework for the Verification, Design and Scaling up of NbS*. 1st ed. Gland, Switzerland: International Union for the Conservation of Nature. doi:10.2305/IUCN.CH.2020.08.en.
- 13 Sowińska-Świerkosz, B. and J. Garcia. 2022. "What Are Nature-Based Solutions (NBS)? Setting Core Ideas for Concept Clarification." *Nature-Based Solutions* 2 (December): 100009. doi:10.1016/j.nbsj.2022.100009.
- 14 "Nature-Based Solutions' Is the Latest Green Jargon That Means More than You Might Think." 2017. *Nature* 541 (7636): 133–34. doi:10.1038/541133b.
- 15 See pp. 219–221 in: Reid, H. et al. 2021. "Jobs." In *State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World*, 210–35. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- 16 Trisos, C.H. et al. 2022. "Africa." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by H.-O. Pörtner et al., 1285–1455. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.
- 17 For a detailed breakdown, see Figure 9.20 in Trisos et al., 2022, "Africa."
- 18 Opperman, J. et al. 2021. "Waterways to Resilience: Nature-Based Solutions for Adaptation in Africa." Gland, Switzerland: WWF-International. https://wwf.panda.org/wwf_news/?4308241/Nature-based-Solutions-are-critical-to-adaptation-in-Africa.
- 19 See Section 9.9.5 in Trisos et al., 2022, "Africa."
- 20 See <https://www.worldagroforestry.org/about/agroforestry>.
- 21 Garrity, D.P. et al. 2010. "Evergreen Agriculture: A Robust Approach to Sustainable Food Security in Africa." *Food Security* 2 (3): 197–214. doi:10.1007/s12571-010-0070-7.
- 22 Mbow, C. et al. 2014. "Agroforestry Solutions to Address Food Security and Climate Change Challenges in Africa." *Current Opinion in Environmental Sustainability, Sustainability challenges*, 6 (February): 61–67. doi:10.1016/j.cosust.2013.10.014. See abstract and conclusions on p. 65, respectively.
- 23 Nord, A., S. Snapp, and B. Traore. 2022. "Current Knowledge on Practices Targeting Soil Fertility and Agricultural Land Rehabilitation in the Sahel. A Review." *Agronomy for Sustainable Development* 42 (4): 79. doi:10.1007/s13593-022-00808-1.
- 24 IPBES. 2018. "The Assessment Report on Land Degradation and Restoration: Summary for Policymakers." Bonn: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. doi:10.5281/zenodo.3237411.
- 25 Francis, R., P. Weston, and J. Birch. 2015. "The Social, Environmental and Economic Benefits of Farmer Managed Natural Regeneration (FMNR)." *World Vision Australia*. <http://fmnrhub.com.au/wp-content/uploads/2015/04/Francis-Weston-Birch-2015-FMNR-Study.pdf>.
- 26 Wade, A.S.I. et al. 2010. "Management Strategies for Maximizing Carbon Storage and Tree Species Diversity in Cocoa-Growing Landscapes." *Agriculture, Ecosystems & Environment* 138 (3): 324–34. doi:10.1016/j.agee.2010.06.007.
- 27 Tschora, H. and F. Cherubini. 2020. "Co-Benefits and Trade-Offs of Agroforestry for Climate Change Mitigation and Other Sustainability Goals in West Africa." *Global Ecology and Conservation* 22 (June): e00919. doi:10.1016/j.gecco.2020.e00919.

Nature-based Solutions in Agroforestry

continued

- 28 Wurz, A. et al. 2022. "Win-Win Opportunities Combining High Yields with High Multi-Taxa Biodiversity in Tropical Agroforestry." *Nature Communications* 13 (1): 4127. doi:10.1038/s41467-022-30866-8.
- 29 Garrity, D.P., F.K. Akinnifesi, O.C. Ajayi, S.G. Weldesemayat, J.G. Mowo, A. Kalinganire, M. Larwanou and J. Bayala. 2010. Evergreen Agriculture: a robust approach to sustainable food security in Africa. *Food Security* 2:197-214; Haskett, J.D., B. Simane, and C. Smith. 2019. "Energy and Climate Change Mitigation Benefits of *Faidherbia albida* Agroforestry in Ethiopia." *Frontiers in Environmental Science* 7, 146 doi: 10.3389/fenvs.2019.00146
- 30 Lelamo, L.L. 2021. "A Review on the Indigenous Multipurpose Agroforestry Tree Species in Ethiopia: Management, Their Productive and Service Roles and Constraints." *Heliyon* 7 (9): e07874. doi:10.1016/j.heliyon.2021.e07874.
- 31 Lelamo, 2021, "A Review on the Indigenous Multipurpose Agroforestry Tree Species in Ethiopia."
- 32 Sanou, L. et al. 2019. "Drivers of Farmers' Decisions to Adopt Agroforestry: Evidence from the Sudanian Savanna Zone, Burkina Faso." *Renewable Agriculture and Food Systems* 34 (2): 116–33. doi:10.1017/S1742170517000369.
- 33 UNEP. 2019. "Financing the Transition to Agroforestry." United Nations Environment Programme. December 6. <http://www.unep.org/news-and-stories/story/financing-transition-agroforestry>.
- 34 Kuyah, S. et al. 2020. "Potential of Agroforestry to Enhance Livelihood Security in Africa." In *Agroforestry for Degraded Landscapes*, edited by J.C. Dagar, S.R. Gupta, and D. Teketay, 135–67. Singapore: Springer Singapore. doi:10.1007/978-981-15-4136-0_4.
- 35 See <https://www.bonncchallenge.org> and <https://afr100.org>.
- 36 Winterbottom, B., C. Reij, and G.H. Stirrett Wood. 2021. "Sustainable Land Management in the Sahel: Lessons from the Sahel and West Africa Program in Support of the Great Green Wall (SAWAP)." Washington, DC: World Bank Group. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/343311608752196338/sustainable-land-management-in-the-sahel-lessons-from-the-sahel-and-west-africa-program-in-support-of-the-great-green-wall-sawap>.
- 37 Soanes, M. et al. 2019. "Money Where It Matters: Designing Funds for the Frontier." London: International Institute for Environment and Development. <https://www.iied.org/10199iied>.
- 38 IPBES. 2018. *The IPBES Regional Assessment Report on Biodiversity and Ecosystem Services for Africa*. Edited by E. Archer et al. Bonn: Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. <http://doi.org/10.5281/zenodo.3236178>.
- 39 See Section 9.4.2.2 in Trisos et al., 2022, "Africa."
- 40 Ostrom, E. 2010. "Polycentric Systems for Coping with Collective Action and Global Environmental Change." *Global Environmental Change*, 20th Anniversary Special Issue, 20 (4): 550–57. doi:10.1016/j.gloenvcha.2010.07.004.
- 41 Carlisle, K. and R.L. Gruby. 2019. "Polycentric Systems of Governance: A Theoretical Model for the Commons." *Policy Studies Journal* 47 (4): 927–52. doi:10.1111/psj.12212.
- 42 See Section 9.1.5 and Figure 9.3 in Trisos et al., 2022, "Africa." See also Overland, I. et al. 2022. "Funding Flows for Climate Change Research on Africa: Where Do They Come from and Where Do They Go?" *Climate and Development* 14 (8): 705–24. doi:10.1080/17565529.2021.1976609.
- 10 See, for example: Lallemand, P. 2021. "Socio-Economic Assessment of Blue Potential in Seychelles." Presentation slides. United Nations Economic Commission for Africa. <https://www.uneca.org/sites/default/files/Blue%20Economy%20Valuation%20Toolkit%20for%20Seychelles%20-%20Philippe%20Lallemand.pdf>. Ahmed, Z. Q. 2021. "Evaluation Du Potentiel et de La Contribution de l'économie Bleue - Djibouti." Presentation slides. United Nations Economic Commission for Africa. <https://www.uneca.org/sites/default/files/SROs/Evaluation%20Economie%20bleue-Djibouti.pdf>.
- 11 AU-IBAR. 2020. "Africa Blue Economy Strategy – Blue Governance Framework." Nairobi: African Union – Inter-African Bureau for Animal Resources. <https://www.researchgate.net/publication/346922579>.
- 12 COMESA. 2022. "Coming Soon: A Regional Blue Economy Strategy." Common Market for Eastern and Southern Africa. April 27. <https://www.comesa.int/coming-soon-a-regional-blue-economy-strategy/>.
- 13 IGAD. 2022. "Regional Blue Economy Strategy and Implementation Plan for 5 Years (2021–2025)." Djibouti: Intergovernmental Authority on Development. <https://igad.int/wp-content/uploads/2022/03/IGAD-Blue-Strategy-Draft.pdf>. Note that the policy was first drafted in 2020, but only approved in April 2022. See also the IGAD web page on the Blue Economy. <https://igad.int/agriculture-environment/environment-protection-2/igad-blue-economy/>.
- 14 Pibasso, A.M. 2022. "CEEAC: l'économie bleue au centre des objectifs du développement." *Financial Afrik* (blog), June 14. <https://www.financialafrik.com/2022/06/14/ceeac-leconomie-bleue-au-centre-des-objectifs-du-developpement/>.
- 15 See <https://ioc.unesco.org/topics/blue-economy>.
- 16 Castañón-Isaza, J. and S.M. Diez. 2021. "Protecting Oceans from Climate Change Impacts Blue Economy." *Development and a Changing Climate – World Bank* (blog), November 24. <https://blogs.worldbank.org/climatechange/protecting-oceans-climate-change-impacts>. See also the IOC's resource page on MSP: <https://ioc.unesco.org/our-work/marine-spatial-planning>.
- 17 Smith, J., H. Sims, and A. de Comarmond. 2021. "Case Study: Seychelles – Using Marine Spatial Planning to Meet the 30 Per Cent Marine Protected Areas Target." *The Commonwealth*. February 10. <https://thecommonwealth.org/case-study/case-study-seychelles-using-marine-spatial-planning-meet-30-cent-marine-protected-areas>.
- 18 UNECA. 2021. "Socio-Economic Assessment of the Blue Economy in Seychelles." Preliminary Analytical Report – April 2021. Addis Ababa: United Nations Economic Commission for Africa. <https://www.uneca.org/sites/default/files/SROs/Preliminary%20Analytical%20Report%20-%20Seychelles.pdf>.
- 19 UNEP-Nairobi Convention and WIOMSA. 2021. "Western Indian Ocean Marine Protected Areas Outlook: Towards Achievement of the Global Biodiversity Framework Targets." Nairobi: United Nations Environment Programme and Western Indian Ocean Marine Science Association. <http://www.unep.org/resources/report/marine-protected-areas-outlook>.
- 20 Pillay, D. et al. 2010. "Ecosystem Change in a South African Marine Reserve (1960–2009): Role of Seagrass Loss and Anthropogenic Disturbance." *Marine Ecology Progress Series* 415 (September): 35–48. doi:10.3354/meps08733.
- 21 Duvat, V.K.E., A. Anisimov, and A.K. Magnan. 2020. "Assessment of Coastal Risk Reduction and Adaptation-Labelled Responses in Mauritius Island (Indian Ocean)." *Regional Environmental Change* 20 (4): 110. doi:10.1007/s10113-020-01699-2.
- 22 Cervigni, R. and P.L. Scandizzo, eds. 2017. *The Ocean Economy in Mauritius: Making It Happen, Making It Last*. Washington, DC: World Bank. <http://hdl.handle.net/10986/28562>. (p. 103)
- 23 Government of Cabo Verde. 2021. "Cabo Verde 2020 Update to the First Nationally Determined Contribution (NDC)." Praia: Ministry of Agriculture and Environment. https://unfccc.int/sites/default/files/NDC/2022-06/Cabo%20Verde_NDC%20Update%202021.pdf. (p. 40)
- 24 For an overview of the concept of blue carbon, see Lovelock, C.E. and C.M. Duarte. 2019. "Dimensions of Blue Carbon and Emerging Perspectives." *Biology Letters* 15 (3): 20180781. doi:10.1098/rsbl.2018.0781. For an example of assessments of the potential for blue carbon storage in Africa, see Kauffman, J.B. and R.K. Bhomia. 2017. "Ecosystem Carbon Stocks of Mangroves across Broad Environmental Gradients in West-Central Africa: Global and Regional Comparisons." *PLOS ONE* 12 (11): e0187749. doi:10.1371/journal.pone.0187749.
- 25 Costanza, R. et al. 2014. "Changes in the Global Value of Ecosystem Services." *Global Environmental Change* 26 (May): 152–58. doi:10.1016/j.gloenvcha.2014.04.002.
- 26 Temmerman, S. et al. 2013. "Ecosystem-Based Coastal Defence in the Face of Global Change." *Nature* 504 (7478): 79–83. doi:10.1038/nature12859.
- 27 Herr, D. and E. Landis. 2020. "Coastal Blue Carbon Ecosystems: Opportunities for Nationally Determined Contributions." Policy Brief. Gland, Switzerland: International Union for Conservation of Nature and The Nature Conservancy. <http://www.unep.org/resources/policy-and-strategy/coastal-blue-carbon-ecosystems-opportunities-nationally-determined>.
- 28 Temmerman et al., 2013, "Ecosystem-Based Coastal Defence in the Face of Global Change."

Coastal Erosion

- 1 Small, C. and Nicholls, R.J. (2003). A global analysis of human settlement in coastal zones. *Journal of Coastal Research*, 19(3), 584-599. West Palm Beach (Florida).
- 2 OECD (2022). Ocean shipping and shipbuilding.
- 3 WBG (2017). Western Africa Container Terminals Concessions - Making the Most of Ports in West Africa. World Bank, 1818 H Street NW, Washington, DC 20433, USA.
- 4 De Boer (2019). Mapping the Sandy Beach Evolution Around Seaports at the Scale of the African Continent. *J. Mar. Sci. Eng.* 2019, 7(5), 151.
- 5 de Boer, Wiebe, Yongjing Mao, Gerben Hagenaaers, Sierd de Vries, Jill Slinger, and Tiedo Vellinga. 2019. "Mapping the Sandy Beach Evolution Around Seaports at the Scale of the African Continent" *Journal of Marine Science and Engineering* 7, no. 5: 151. <https://doi.org/10.3390/jmse7050151>
- 6 de Boer, Wiebe, Yongjing Mao, Gerben Hagenaaers, Sierd de Vries, Jill Slinger, and Tiedo Vellinga. 2019. "Mapping the Sandy Beach Evolution Around Seaports at the Scale of the African Continent" *Journal of Marine Science and Engineering* 7, no. 5: 151. <https://doi.org/10.3390/jmse7050151>
- 7 WBG (2019). The Cost of Coastal Zone Degradation in West Africa. World Bank,
- 8 WBG (2019). The Cost of Coastal Zone Degradation in West Africa. World Bank
- 9 World Bank Group. 2021. Disappearing Coasts in the Maghreb: Coastal Erosion and its Costs. Washington, D.C.
- 10 ADB (2022). African Ports and the Blue Economy Nexus: Institutional, Policy and Governance Arrangements. African Natural Resources Centre (ANRC) of the African Development Bank.
- 11 Anthony, E.J. et al. (2014). Human influence and the changing geomorphology of Mediterranean deltas and coasts over the last 6000 years: From progradation to destruction phase? *Earth-Science Reviews*, Volume 139, 2014, 336-361. <https://doi.org/10.1016/j.ear>
- 12 MOLOA (2020). West Africa Coastal Areas Assessment. UEMOA, 2021.
- 13 Knowable Magazine (2020). The tides they are a-changin' – and it's not just from climate change. Posted on 22 April, 2020, accessed on August 30, 2022.
- 14 Odériz, I. (2021). Natural Variability and Warming Signals in Global Ocean Wave Climates. *Geophysical Research Letters*, Volume 48, Issue 11, 16 June 2021.
- 15 Odériz, I. (2022). Transitional wave climate regions on continental and polar coasts in a warming world. *Nature Climate Change*. 12, 662–671 (2022).
- 16 IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability.
- 17 IPCC (2022). IPCC AR6 WGII Fact Sheet – Africa.
- 18 IPCC (2014). AR5 Synthesis Report: Climate Change 2014. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, 151 pp
- 19 WBG (2020). Effects of climate change on coastal erosion and flooding: in Benin, Côte d'Ivoire, Mauritania, Senegal, and Togo. Commissioned by the West Africa Coastal Areas Program (WACA) under WBG. May 2020.
- 20 WBG (2019). The Cost of Coastal Zone Degradation in West Africa. World Bank
- 21 WBG (2022). Compendium: Coastal Management Practices in West Africa. World Bank,
- 22 Jambek, J.R. et al. (2015). Plastic waste inputs from land into the ocean. *Science* 13 Feb 2015 Vol 347, Issue 6223 pp. 768-771. DOI: 10.1126/science.1260352
- 23 Lebreton, L., Andrady, A. (2019). Future scenarios of global plastic waste generation and disposal. *Palgrave Commun* 5, 6. <https://doi.org/10.1057/s41599-018-0212-7>
- 24 ORLOA (2020). Coastal reviews 2020. West African Regional Coastal Observatory (ORLOA), in collaboration with WACA, UEMOA, and MOLOA.
- 25 <https://www.cse.sn/>
- 26 22 UEMOA, 2022. Réunion des ministres et autorités chargés de l'environnement sur la gestion des zones côtières et marines, la biodiversité et les aires protégées. Final declaration of the Ministries of environment acceptance of the 2020 State of the coast report. Dakar, June 17, 2022.
- 27 ORLOA (2020). Coastal reviews 2020. West African Regional Coastal Observatory (ORLOA), in collaboration with WACA, UEMOA, and MOLOA.
- 28 ORLOA (2020). Coastal reviews 2020. West African Regional Coastal Observatory (ORLOA), in collaboration with WACA, UEMOA, and MOLOA.
- 29 Powell, E.J. et al. (2018). A review of coastal management approaches to support the integration of ecological and human community planning for climate change. *Coastal Conservation* 23, 1-18 (2019). <https://doi.org/10.1007/s11852-018-0632-y>
- 30 Gracia, A. et al. (2018). Use of ecosystems in coastal erosion management. *Ocean and Coastal Management*, Volume 156, 2018, 277-289. <https://doi.org/10.1016/j.ocecoaman.2017.07.009>
- 31 European Commission (2022). The vital role of nature-based solutions in a nature positive economy. Published on 27 April 2022 by the Directorate-General for Research and Innovation (European Commission).
- 32 United Nations Environment Programme (2021). State of Finance for Nature 2021. Nairobi.
- 33 Spalding M, McIvor A, Tonnejck FH, Tol S and van Eijk P (2014) Mangroves for coastal defence. Guidelines for coastal managers & policy makers. Published by Wetlands International and The Nature Conservancy. 42 p
- 34 Menendez, P., Losada, I.J., Torres-Ortega, S., Narayan, S., and Beck, M.W. (2020). Global Flood Protection Benefits of Mangroves. *Scientific Reports* volume 10, Article: 4404.
- 35 ORLOA (2020). Coastal reviews 2020. West African Regional Coastal Observatory (ORLOA), in collaboration with WACA, UEMOA, and MOLOA.
- 36 ORLOA (2020). Coastal reviews 2020. West African Regional Coastal Observatory (ORLOA), in collaboration with WACA, UEMOA, and MOLOA.
- 37 WACA (2022). WACA website. World Bank Group, accessed August, 29 2022.
- 38 WACA (2022). Project WACA: bilan et perspectives avec Christophe DEGUENON. WACA video posted on YouTube on July 23, 2022.
- 39 WBG (2022). West Africa Coastal Areas Resilience Investment Project 2. World Bank webpage, accessed on August 30, 2022.
- 40 WBG (2022). West Africa Coastal Areas Resilience Investment Project 2. World Bank webpage, accessed on August 30, 2022.
- 41 WACA (2020). WACA Call For Innovation e-book. World Bank Group, 2020.
- 42 WBG (2022). Compendium: Coastal Management Practices in West Africa. World Bank,
- 43 WBG (2022). Compendium: Coastal Management Practices in West Africa. World Bank,
- 44 ABDIJAN (2012). Land-based pollution control. Abidjan Convention, 2012.
- 45 ABDIJAN (2020). Additional protocol to the Abidjan convention on sustainable mangrove management. 12th meeting of the Contracting Parties to the Convention on Cooperation for the Protection, Management and Development of the Marine Environment and Coastal Areas. UNEP.
- 46 WBG (2022). The Economics of Large-scale Mangrove Conservation and Restoration in Indonesia. World Bank, 1818 H Street NW, Washington, DC 20433, USA.
- 47 WBG (2019). Mangroves for Coastal Protection Evidence from Hurricanes in Central America. Policy Research Working Paper 8795. World Bank
- 48 ORLOA (2020). Coastal reviews 2020. West African Regional Coastal Observatory (ORLOA), in collaboration with WACA, UEMOA, and MOLOA.
- 49 WBG (2022). Compendium: Coastal Management Practices in West Africa. World Bank
- 50 ORLOA (2020). 2a-DETAILED-MASTER-PLAN-2020-02-Senegal_North. West African Regional Coastal Observatory (ORLOA), in collaboration with WACA, UEMOA, and MOLOA.
- 51 Sadio, M. (2017). Shoreline Changes on the Wave-Influenced Senegal River Delta, West Africa: The Roles of Natural Processes and Human Interventions. *Water* 2017, 9, 357. <https://doi.org/10.3390/w9050357>
- 52 Vedeld, T., et al. (2016). Climate adaptation at what scale? Multi-level governance, resilience, and coproduction in Saint Louis, Senegal. *Natural Hazards* 82, 173-199 (2013). <https://doi.org/10.1007/s11069-015-1875-7>
- 53 36 ORLOA (2020). 2a-DETAILED-MASTER-PLAN-2020-02-Senegal_North. West African Regional Coastal Observatory (ORLOA), in collaboration with WACA, UEMOA, and MOLOA.
- 54 WBG (2021). Blue Skies, Blue Seas: Air Pollution, Marine Plastics, and Coastal Erosion in the Middle East and North Africa. World Bank, 1818 H Street NW, Washington, DC 20433, USA.
- 55 WBG (2021). Distributional Impacts of COVID-19 in the Middle East and North Africa Region. World Bank, 1818 H Street NW, Washington, DC 20433, USA.
- 56 Luijendijk, A. et al. (2018). The State of the World's Beachs. *Scientific Reports*, 8, 6641 (2018). <https://doi.org/10.1038/s41598-018-24630-6>
- 57 WBG (2021). Disappearing coasts in the Maghreb: Coastal erosion and its costs. World Bank, 1818 H Street NW, Washington, DC 20433, USA.
- 58 39 WBG (2021). Blue Skies, Blue Seas: Air Pollution, Marine Plastics, and Coastal Erosion in the Middle East and North Africa.
- 59 Iskander, M.M. (2021). Stability of the Nothern coast of Egypt under the effect of urbanization and climate change. *Water Science*, 35:1, 1-10, <https://doi.org/10.1080/11104929.2020.1864255>
- 60 Masria, A. et al. (2015b). Detection of Shoreline and Land Cover Changes around Rosetta Promontory, Egypt, Based on Remote Sensing Analysis. *Land* 2015, 4, 216-230. <https://doi.org/10.3390/land4010216>
- 61 Masria, A. et al. (2015b). Detection of Shoreline and Land Cover Changes around Rosetta Promontory, Egypt, Based on Remote Sensing Analysis. *Land* 2015, 4, 216-230. <https://doi.org/10.3390/land4010216>
- 62 WBG (2021). Blue Skies, Blue Seas: Air Pollution, Marine Plastics, and Coastal Erosion in the Middle East and North Africa. World Bank
- 63 El Raey, M. (2010). Impact of Sea Level Rise on the Arab Region. University of Alexandria. Arab Academy of Science, Technology, and Maritime.
- 64 Hallegatte, S. (2013). Future flood losses in major coastal cities. *Nature Climate Change* 3, 802-806 (2013). <https://doi.org/10.1038/nclimate1979>
- 65 Deltares (2022). Mangroves as a Protection from Erosion and Coastal Flooding in Selected West African Coastal Countries. 11205569-000-ZKS-0001, 18 May 2022
- 66 Sharaan, M. et al. (2020). Impact of SLR on Beach-Tourism Resort Revenue at Sahl Hasheesh and Makadi Bay, Red Sea, Egypt; A Hedonic Pricing Approach. *Marine Science and Engineering*, 8(6), 432.
- 67 WBG (2021). Blue Skies, Blue Seas: Air Pollution, Marine Plastics, and Coastal Erosion in the Middle East and North Africa. World Bank,
- 68 WBG (2021). Blue Skies, Blue Seas: Air Pollution, Marine Plastics, and Coastal Erosion in the Middle East and North Africa. World Bank
- 69 WB (2022). Unpacking the Plastics Challenge: Using Knowledge, Policies and Innovation to Improve Lives. World Bank blog visited August 30, 2022.
- 70 UNDP (2022). Enhancing Climate Change Adaptation in the North Coast of Egypt. UNDP webpage accessed August 29, 2022.
- 71 UNDP (2022). Enhancing Climate Change Adaptation in the North Coast of Egypt. UNDP webpage accessed August 29, 2022.
- 72 WBG (2021). Preserving Morocco's coastline. WBG webpage, accessed August 29, 2022.
- 73 UNEP (2022). Common Regional Framework for Integrated Coastal Zone Management. UNEP/MED IG.24/22 Page 262.
- 74 KFW (2020). More sand on the beach. Blog published on KfW Stories on 9 March 2020, accessed August 31, 2022.
- 75 Warrick, J.A. et al. (2019). World's largest dam removal reverses coastal erosion. *Sci Rep* 9, 13968 (2019).

Coastal Erosion

continued

- 76 WBG (2021). Blue Skies, Blue Seas: Air Pollution, Marine Plastics, and Coastal Erosion in the Middle East and North Africa. World Bank.
- 77 WBG (2022). Compendium: Coastal Management Practices in West Africa. World Bank.
- 78 WBG (2022). Compendium: Coastal Management Practices in West Africa. World Bank.
- 79 WBG (2021). Blue Skies, Blue Seas: Air Pollution, Marine Plastics, and Coastal Erosion in the Middle East and North Africa
- 80 (2022). Compendium: Coastal Management Practices in West Africa. World Bank.
- 81 WBG (2021). Blue Skies, Blue Seas: Air Pollution, Marine Plastics, and Coastal Erosion in the Middle East and North Africa. World Bank.
- 82 MOLOA (2020). West Africa Coastal Areas Assessment. UEMOA, 2021.
- 83 Deltares (2022). Mangroves as a Protection from Erosion and Coastal Flooding in Selected West African Coastal Countries.
- 84 WBG (2021). Blue Skies, Blue Seas: Air Pollution, Marine Plastics, and Coastal Erosion in the Middle East and North Africa. World Bank
- 85 Syvitski J.P. et al. (2005). Impact of humans on the flux of terrestrial sediment to the global ocean. *Science*. 2005 Apr 15;308(5720):376-80. doi: 10.1126/science.1109454. PMID: 15831750.
- 86 WBG (2022). Compendium: Coastal Management Practices in West Africa. World Bank

The World Bank's Country Climate and Development Report for the G5 Sahel Countries

- 1 World Bank Group. 2022. G5 Sahel Region Country Climate and Development Report. CCDR Series. Washington, DC: World Bank. Available online at: <https://openknowledge.worldbank.org/handle/10986/37620>.

Locally Led Adaptation

- 1 IPCC. 2022. "Summary for Policymakers." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by H.-O. Pörtner et al. Cambridge, UK, and New York: Cambridge University Press (in press). <https://www.ipcc.ch/report/ar6/wg2/>.
- 2 See the Notre Dame Global Adaptation Initiative (ND-GAIN) Country Index vulnerability scores for 2020: <https://gain.nd.edu/our-work/country-index/rankings/>. On the ND-GAIN Index, which also includes scores for readiness, nine of the 10 lowest-scoring countries are in Africa.
- 3 Soanes, M. et al. 2021. "Principles for Locally Led Adaptation: A Call to Action." London: International Institute for Environment and Development. <https://pubs.iied.org/10211iied>.
- 4 Goedde, L., A. Ooko-Ombaka, and G. Pais. 2019. "Winning in African Agriculture: Private-Sector Companies Can Find Practical Solutions to Enter and Grow in Africa's Agricultural Market." McKinsey & Company. <https://www.mckinsey.com/industries/agriculture/our-insights/winning-in-african-agricultural-market>.
- 5 See World Bank data for population living in slums (% of urban population): <https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?locations=ZG>.
- 6 Ministry of Finance. 2017. "Climate Change Financing Framework: A Road Map to Systematically Strengthen Climate Change Mainstreaming into Planning and Budgeting." Kathmandu: Government of Nepal. https://mof.gov.np/uploads/document/file/CCFF_FINAL_Web_20180222050438.pdf.
- 7 USAID. 2022. "USAID Climate Strategy 2022–2030." Washington, DC: U.S. Agency for International Development. <https://www.usaid.gov/climate/strategy>.
- 8 UKFCDO. 2021. "UK Announces £274m Boost to Climate Resilience across Indo-Pacific." Foreign, Commonwealth & Development Office press release. November 8. <https://www.gov.uk/government/news/uk-announces-274m-boost-to-climate-resilience-across-indo-pacific>.
- 9 For example, see GCA. 2022. "GCA CEO and Costa Rican President Rodrigo Chaves Commit to Strong Partnership to Drive Local and Regional Adaptation Action." Global Center on Adaptation press release. July 10. <https://gca.org/news/gca-ceo-and-costa-rican-president-rodrigo-chaves-commit-to-strong-partnership-to-drive-local-and-regional-adaptation-action/>.
- 10 OECD. 2022. *Africa's Urbanisation Dynamics 2022: The Economic Power of Africa's Cities*. Paris: Organisation for Economic Co-operation and Development. <https://doi.org/10.1787/3834ed5b-en>.
- 11 Soanes et al., 2021.
- 12 Singh, C. et al. 2022. "Interrogating 'Effectiveness' in Climate Change Adaptation: 11 Guiding Principles for Adaptation Research and Practice." *Climate and Development* 14 (7): 650–64. doi:10.1080/17565529.2021.1964937.
- 13 Eriksen, S. and K. Brown. 2011. "Sustainable Adaptation to Climate Change." *Climate and Development* 3 (1): 3–6. doi:10.3763/cdev.2010.0064.
- 14 Soanes et al., 2021.
- 15 Santhia, D., S. Shackleton, and T. Pereira. 2018. "Mainstreaming Sustainable Adaptation to Climate Change into Municipal Planning: An Analysis from the Eastern Cape, South Africa." *Development Southern Africa* 35 (4): 589–608. doi:10.1080/0376835X.2018.1488583.

- 16 Singh et al., 2022 (p. 652).
- 17 Chadburn, O. et al. 2013. *Applying Cost Benefit Analysis at a Community Level: A Review of Its Use for Community Based Climate and Disaster Risk Management*. Oxfam Research Report. Oxford: Oxfam GB. <https://oxfamlibrary.openrepository.com/handle/10546/303558>.
- 18 Tschakert, P. et al. 2017. "Climate Change and Loss, as If People Mattered: Values, Places, and Experiences." *WIREs Climate Change* 8 (5): e476. doi:10.1002/wcc.476.
- 19 Vardakoulis, O. and N. Nicholles. 2015. "A Socio-Economic Evaluation of Community-Based Adaptation: A Case Study in Dakoro, Niger." In *Handbook of Climate Change Adaptation*, edited by W. Leal Filho, 37–70. Berlin and Heidelberg: Springer. doi:10.1007/978-3-642-38670-1_125.
- 20 Wong, S. and S. Guggenheim. 2018. "Community-Driven Development: Myths and Realities." Policy Research Working Paper No. 8435. Washington, DC: World Bank. <http://hdl.handle.net/10986/29841>.
- 21 Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press. doi:10.1017/CBO9780511807763.
- 22 Soanes et al., 2021.
- 23 Buhukya, S. 2014. "An Empirical Analysis And Implications Of Social Audit In Mgnregs With Special Reference To Andhra Pradesh." *Global Journal For Research Analysis-GJRA*/article/an-empirical-analysis-and-implications-of-social-audit-in-mgnregs-with-special-reference-to-andhra-pradesh/MTE2NzM=/.
- 24 Kirkby, P., C. Williams, and S. Huq. 2015. "A Brief Overview of Community-Based Adaptation." Dhaka: International Centre for Climate Change and Development. <https://www.icccad.net/publications/policy-brief/a-brief-overview-of-community-based-adaptation/> (pp.1–2).
- 25 IFAD. 2013. "Community Driven Development." International Fund for Agricultural Development. July 1. <https://www.ifad.org/en/web/ioe/w/community-driven-development>.
- 26 Shakya, C. et al. 2018. "Building Institutional Capacity for Enhancing Resilience to Climate Change: An Operational Framework and Insights from Practice." *Action on Climate Today (ACT) Learning Paper*. Oxford Policy Management. <https://reliefweb.int/report/nepal/building-institutional-capacity-enhancing-resilience-climate-change-operational>.
- 27 See <https://fnec-benin.org>.
- 28 See <https://www.mofed.gov.et/programmes-projects/crge-facility/>.
- 29 See <https://www.eif.org/na>.
- 30 See <http://www.fonerwa.org>.
- 31 See <https://www.sanbi.org>.
- 32 The PSNP, established in 2005, has been widely studied. See, e.g. Scognamiglio, A., M. Mastrorillo, and A. Ignaciuk. 2022. "Reducing Vulnerability to Weather Shocks through Social Protection – Evidence from the Implementation of Productive Safety Net Programme (PSNP) in Ethiopia." FAO Agricultural Development Economics Working Paper No. 22-02. Rome: Food and Agriculture Organization of the United Nations. doi:10.4060/cc0824en.
- 33 See <https://www.hsnr.or.ke>.
- 34 See the project page on the World Bank website: <https://projects.worldbank.org/en/projects-operations/project-detail/P002952>.
- 35 See the project page on the DAI website: <https://www.dai.com/our-work/projects/ethiopia-technical-assistance-to-support-gcca-plus-mainstreaming-of-climate-smart-planning-and-implementation-approaches>.
- 36 See <http://www.ourmicronesia.org>.
- 37 See <https://canari.org>.
- 38 See <https://sdinet.org>.
- 39 See <https://huairou.org>.
- 40 See <https://pawankafund.org>.
- 41 Women Build Community. 2021. "Shibuye Community Health Workers (SCHW)." <https://www.womenbuildcommunity.org/case/shibuye-community-health-workers-schw/>.
- 42 CAHF. 2021. "Gungano Urban Poor Fund." Johannesburg: Centre for Affordable Housing Finance in Africa. https://housingfinanceafrica.org/app/uploads/2021/12/10-Zimbabwe_-Gungano-Urban-Poor-Fund-June-2021.pdf.
- 43 Christensen, E. et al. 2022. "What Do Microfinance Clients Need to Adapt to Climate Change?" *FinDev Blog*, April 22. <https://www.findevgateway.org/blog/2022/04/what-do-microfinance-clients-need-adapt-climate-change>.
- 44 CIF. 2018. "Microfinance for Adaptation: From Readiness to Resilience." Knowledge for Resilience Research Brief. Washington, DC: Climate Investment Funds. https://www.climateinvestmentfunds.org/sites/cif_enc/files/knowledge-documents/micro-finance_research_brief.pdf.
- 45 Global Infrastructure Hub. 2021. "Cape Town Green Bond." Case study. November 1. <https://www.gihub.org/innovative-funding-and-financing/case-studies/cape-town-green-bond/>.
- 46 C40. 2017. "Explainer: How to Finance Urban Infrastructure." C40 Knowledge Hub Implementation Guide, September. https://www.c40knowledgehub.org/s/article/Explainer-How-to-finance-urban-infrastructure?language=en_US.
- 47 See <https://www.aecfafrica.org/approach/our-programmes/renewable-energy/renewable-energy-and-adaptation-to-climate-change-window/>.
- 48 See <https://kigali.impacthub.net/ignite-food-systems-challenge/>.
- 49 See the Climate Funds Update Data Dashboard: <https://climatefundsupdate.org/data-dashboard/#1541245745457-d3cda887-f010> (data listed for most funds up to date as of January 2022).
- 50 Lewis, S., C. Shakya, and P. Steele. 2017. "Money Where It Matters: Financing the Sustainable Development Goals and Paris Agreement through Local Finance." Event report. London: International Institute for Environment and Development. <https://www.iied.org/17419iied>.

Locally Led Adaptation

continued

- 51 See <https://www.mofed.gov.et/programmes-projects/crge-facility/>.
- 52 See <https://www.dffe.gov.za/projectsprogrammes/greenfund>.
- 53 See the UNFCCC NAP repository: <https://www4.unfccc.int/sites/NAPC/Pages/national-adaptation-plans.aspx>.
- 54 See the UNFCCC NAPA repository: <https://unfccc.int/topics/resilience/workstreams/national-adaptation-programmes-of-action/napas-received>.
- 55 Ndegwa, S.N. 2003. "Decentralization in Africa: Emerging Trends and Progress." Africa Region Findings & Good Practice Infobrief No. 229. Washington, DC: World Bank. <http://hdl.handle.net/10986/9726>.
- 56 Erk, J. 2014. "Federalism and Decentralization in Sub-Saharan Africa: Five Patterns of Evolution." *Regional & Federal Studies* 24 (5): 535–52. doi:10.1080/13597566.2014.971769.
- 57 Dodman, D. 2017. "A Special Approach to Slum Upgrading: The Special Planning Area in Mukuru, Nairobi." International Institute for Environment and Development blog, October 18. <https://www.iied.org/special-approach-slum-upgrading-special-planning-area-mukuru-nairobi>.
- 58 Horn, P. 2021. "Enabling Participatory Planning to Be Scaled in Exclusionary Urban Political Environments: Lessons from the Mukuru Special Planning Area in Nairobi." *Environment and Urbanization* 33 (2): 519–38. doi:10.1177/09562478211011088.
- 59 Weru, J. and W. Cobbett. 2021. "Slum Upgrading in Kenya: What Are the Conditions for Success?" Trust.Org (blog), February 25. <https://news.trust.org/item/20210225133836-td97u/>.
- 60 DCF Alliance. 2019. "The Devolved Climate Finance Mechanisms: Principles, Implementations and Lessons from Four Semi-Arid Countries." <https://pubs.iied.org/G04424/>.
- See also Koulibaly, P.S., A. Keita, and J. Abdella. 2017. "Building Resilience at the Local Level: Community-Prioritised Investments in Adaptation." Case Study. Syracuse, NY, US: Near East Foundation.
- 61 DCF Alliance, 2019.
- 62 DCF Alliance, 2019.
- 63 See the project page on the World Bank website: <https://projects.worldbank.org/en/projects-operations/project-detail/P173065>.
- 64 Wakaya, J. 2021. "WB-Funded FLoCa Program Has Facilitated Climate Action in 32 Counties: Treasury." *Capital News*, November 24. <https://www.capitalfm.co.ke/news/2021/11/wb-funded-floca-program-has-facilitated-climate-action-in-32-counties-treasury/>.
- See also the video of the World Bank event "Locally Led Climate Action in Kenya," held on November 8, 2021: <https://live.worldbank.org/cop26-locally-led-climate-action-kenya>.
- 65 See Conservation Namibia's web page on Namibian Communal Conservancies: <https://conservationnamibia.com/factsheets/communal-conservancies.php>.
- 66 See the Empower to Adapt web page for Component 2: Resilient Grant Facility for CBNRM Livelihoods in Namibia (accessed October 4, 2022): <https://cbrnm.eif.org.na/pages/component2>.
- 67 GCF. 2019. "GCF in Brief: Enhancing Direct Access." Text. Incheon: Green Climate Fund. <https://www.greenclimate.fund/document/gcf-brief-enhancing-direct-access>.
- 68 See <https://www.uncdf.org/local/homepage>.
- 69 See <https://www.uncdf.org/local/performance-based-grants-for-climate-resilience>.
- 70 Caldwell, M. and G. Larsen. 2021. "Improving Access to the Green Climate Fund: How the Fund Can Better Support Developing Country Institutions." Working Paper. Washington, DC: World Resources Institute. <https://www.wri.org/research/improving-access-green-climate-fund-how-fund-can-better-support-developing-country>.
- 71 Sanusi, A., A. Tabi'u, and A.M. Mohamed. 2013. "Governance in Nigeria: Assessing the Effects of the State Joint Local Government Account." *Journal of Governance and Development* 9 (151–164). <https://core.ac.uk/download/pdf/42979262.pdf> (p. 159).
- 72 OECD, 2022.
- 73 Williams, D.S. et al. 2020. "Identifying Local Governance Capacity Needs for Implementing Climate Change Adaptation in Mauritius." *Climate Policy* 20 (5): 548–62. doi:10.1080/14693062.2020.1745743 (p. 557).
- 74 Soanes et al., 2021.
- 75 Soanes et al., 2021.
- 76 Bader, D.A. et al. 2018. "Urban Climate Science." In *Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network*, edited by C. Rosenzweig et al., 27–60. Cambridge, UK, and New York: Cambridge University Press. <https://www.cambridge.org/us/academic/subjects/earth-and-environmental-science/climatology-and-climate-change/climate-change-and-cities-second-assessment-report-urban-climate-change-research-network>.
- 77 Pidcock, R. 2016. "In-Depth: The Scientific Challenge of Extreme Weather Attribution." *Carbon Brief*, March 11. <https://www.carbonbrief.org/in-depth-the-scientific-challenge-of-extreme-weather-attribution/>.
- 78 Aylett, A. 2015. "Institutionalizing the Urban Governance of Climate Change Adaptation: Results of an International Survey." *Urban Climate, Building Capacity for Climate Change Adaptation in Urban Areas*, 14 (December): 4–16. doi:10.1016/j.uclim.2015.06.005.
- 79 See <https://www.citygapfund.org>.
- 80 GCF. 2022. "Green Climate Fund Board Streamlines Access to Finance in Major Accreditation Review USD 187.7 Million Also Approved for New Climate Projects." Green Climate Fund press release, April 1. <https://www.greenclimate.fund/news/green-climate-fund-board-streamlines-access-finance-major-accreditation-review-usd-1877-million>.

Education

- 1 Anderson, A. 2012. "Climate Change Education for Mitigation and Adaptation." *Journal of Education for Sustainable Development* 6 (2): 191–206. doi:10.1177/0973408212475199.
- Muttarak, R. and W. Lutz. 2014. "Is Education a Key to Reducing Vulnerability to Natural Disasters and Hence Unavoidable Climate Change?" *Ecology and Society* 19 (1): Art. 42. doi:10.5751/ES-06476-190142.
- Feinstein, N.W. and K.J. Mach. 2020. "Three Roles for Education in Climate Change Adaptation." *Climate Policy* 20 (3): 317–22. doi:10.1080/14693062.2019.1701975.
- O'Neill, B.C. et al. 2020. "The Effect of Education on Determinants of Climate Change Risks." *Nature Sustainability* 3 (7): 520–28. doi:10.1038/s41893-020-0512-y.
- 2 See <https://www.climate-change.org/en/get-involved/african-coalitions/coalition-for-education-and-training-on-climate-change-in-africa/>.
- 3 African Union. 2022. "African Union Climate Change and Resilient Development Strategy and Action Plan (2022–2032)." Addis Ababa. <https://au.int/en/documents/20220628/african-union-climate-change-and-resilient-development-strategy-and-action-plan>.
- SADC. 2015. "Climate Change Strategy and Action Plan." Gaborone: Southern African Development Community. <https://www.sadc.int/document/sadc-climate-change-strategy-and-action-plan-english>.
- 4 See the summit co-chairs' conclusions: <https://ukcop26.org/co-chairs-conclusions-of-education-and-environment-ministers-summit-at-cop26/>.
- 5 See <https://www.un.org/en/transforming-education-summit>.
- 6 Kwauk, C. 2022. "4 Alarming Findings about Education across Countries' Nationally Determined Contributions." *Education International*, May 31. <https://www.ei-ie.org/en/item/26536:4-alarming-findings-about-education-across-countries-nationally-determined-contributions>.
- 7 UN DESA. 2022. "World Population Prospects 2022." New York: United Nations Department of Economic and Social Affairs, Population Division. <http://esa.un.org/unpd/wpp/>. Africa's population is getting older, but it is still very young: the median age today is about 19, and it is projected to be 24 in 2050.
- 8 UNICEF and African Union Commission. 2021. "Transforming Education in Africa: An Evidence-Based Overview and Recommendations for Long-Term Improvements." New York and Addis Ababa: United Nations Children's Fund and African Union Commission. <https://www.unicef.org/reports/transforming-education-africa>.
- 9 Coffee, J. 2013. "2013 ND-GAIN Data Show World's Poorest Countries Lag 100 Years behind Richest in Preparing for Climate Change." *Notre Dame Global Adaptation Initiative*, December 12. <https://gain.nd.edu/news/2013-nd-gain-data-show-worlds-poorest-countries-lag-100-years-behind-richest-in-preparing-for-climate-change-3/>.
- The 2020 ND-GAIN Country Index still shows enormous disparities, and 9 of the 10 lowest-ranked countries are in Africa. See <https://gain.nd.edu/our-work/country-index/>.
- 10 UNICEF. 2019. "It Is Getting Hot: Call for Education Systems to Respond to the Climate Crisis – Perspectives from East Asia and the Pacific." Bangkok: United Nations Children's Fund, East Asia and Pacific Regional Office. <https://www.unicef.org/eap/reports/it-getting-hot>.
- Randell, H. and C. Gray. 2019. "Climate Change and Educational Attainment in the Global Tropics." *Proceedings of the National Academy of Sciences* 116 (18): 8840–45. doi:10.1073/pnas.1817480116.
- For a review of the evidence from Africa, see Section 9.11.1.2 in Trisos, C.H. et al. 2022. "Africa." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by H.-O. Pörtner et al., 1285–1455. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.
- 11 UNICEF. 2019. "Cyclone Idai: Education at Risk for More than 305,000 Children in Mozambique." United Nations Children's Fund press release, April 18. <https://www.unicef.org/press-releases/cyclone-idai-education-risk-more-305000-children-mozambique-unicef>.
- 12 Torres, J. et al. 2019. "UNESCO Guidelines for Assessing Learning Facilities in the Context of Disaster Risk Reduction and Climate Change Adaptation, Volume 1: Introduction to Learning Facilities Assessment and to the VISUS Methodology." Paris: United Nations Educational, Scientific and Cultural Organization. <https://unesdoc.unesco.org/ark:/48223/pf00000371185.locale=en>.
- 13 World Vision. 2019. "When Disaster Strikes: How Education and Children's Futures Were Battered by Cyclone Idai." April 17. <https://theirworld.org/news/cyclone-idai-batters-education-children-futures-mozambique-malawi-zimbabwe/>.
- 14 GFDRR. 2019. "Zimbabwe Rapid Impact Needs Assessment (2019)." Global Facility for Disaster Risk Reduction and Recovery. Washington, DC: World Bank. <https://www.gfdrr.org/en/publication/zimbabwe-rapid-impact-needs-assessment-2019>.
- 15 See Section 9.11.1.2 in Trisos et al., 2022, "Africa."
- 16 Thacker, S. 2013. "Education and Climate Change in the Middle East and North Africa." *Arab Voices – World Bank Blogs* (blog), October 9. <https://blogs.worldbank.org/arabvoices/education-and-climate-change-middle-east-and-north-africa>.
- 17 Goodman, J. et al. 2018. "Heat and Learning." NBER Working Paper 24639. Cambridge, MA, US: National Bureau of Economic Research. doi:10.3386/w24639.
- 18 UNICEF and WHO. 2020. "Progress on Drinking-Water, Sanitation and Hygiene in Schools." New York: United Nations Children's Fund and World Health Organization. <https://www.who.int/publications-detail-redirect/9789280651423>.
- 19 Sommer, M. et al. 2016. "A Time for Global Action: Addressing Girls' Menstrual Hygiene Management Needs in Schools." *PLOS Medicine* 13 (2): e1001962. doi:10.1371/journal.pmed.1001962.
- 20 Cooper-Vince, C.E. et al. 2017. "Household Water Insecurity, Missed Schooling, and the Mediating Role of Caregiver Depression in Rural Uganda." *Global Mental Health* 4: e15. doi:10.1017/gmh.2017.14.
- Miuro, G. et al. 2018. "Menstrual Health and School Absenteeism among Adolescent Girls in Uganda (MENISCUS): A Feasibility Study." *BMC Women's Health* 18 (1): 4. doi:10.1186/s12905-017-0502-z.

Education
continued

- 21 Chigwanda, E. 2016. "A Framework for Building Resilience to Climate Change through Girls' Education Programming." 2016 Echinidna Global Scholars Policy Brief. Washington, DC: Center for Universal Education, Brookings Institution. <https://www.brookings.edu/research/a-framework-for-building-resilience-to-climate-change-through-girls-education-programming/>.
- 22 Porter, C. 2021. "Education Is under Threat from Climate Change – Especially for Women and Girls." University of Oxford. November 8. <https://www.ox.ac.uk/news/features/education-under-threat-climate-change-especially-women-and-girls>.
- 23 See section 9.10 and Box 9.7 in Trisos et al., 2022, "Africa."
- 24 Randell and Gray, 2019, "Climate Change and Educational Attainment in the Global Tropics."
- 25 WHO. 2012. "Integrating Sexual and Reproductive Health into Health Emergency and Disaster Risk Management." Policy brief by the Reproductive Health Sub-working Group of the ISDR/WHO Thematic Platform for Disaster Risk Management for Health. Geneva: World Health Organization. <https://www.who.int/publications/i/item/integrating-sexual-and-reproductive-health-into-health-emergency-and-disaster-risk-management>.
- 26 Sahiledengle, B. et al. 2022. "Menstrual Hygiene Practice among Adolescent Girls in Ethiopia: A Systematic Review and Meta-Analysis." PLOS ONE 17 (1): e0262295. doi:10.1371/journal.pone.0262295.
- Jewitt, S. and H. Ryley. 2014. "It's a Girl Thing: Menstruation, School Attendance, Spatial Mobility and Wider Gender Inequalities in Kenya." *Geoforum* 56 (September): 137–47. doi:10.1016/j.geoforum.2014.07.006.
- 27 Barnwell, G. 2021. "The Psychological and Mental Health Consequences of Climate Change in South Africa." Cape Town: Centre for Environmental Rights. <https://cer.org.za/reports/the-psychological-and-mental-health-consequences-of-climate-change-in-south-africa>.
- Mupfumira, E.B. 2019. "Helping Chimanimani Children Survive Cyclone Idai Trauma." UNICEF Zimbabwe. March 27. <https://www.unicef.org/zimbabwe/stories/helping-chimanimani-children-survive-cyclone-idai-trauma>.
- 28 IDMC. 2022. "2022 Global Report on Internal Displacement: Children and Youth in Internal Displacement." Geneva: Internal Displacement Monitoring Centre. <https://www.internal-displacement.org/publications/2022-global-report-on-internal-displacement>. See Figure 47 (p. 102) for a detailed breakdown of displaced children by age and sex.
- 29 Graham, J.P., M. Hirai, and S.-S. Kim. 2016. "An Analysis of Water Collection Labor among Women and Children in 24 Sub-Saharan African Countries." PLOS ONE 11 (6): e0155981. doi:10.1371/journal.pone.0155981.
- Kabi, P. 2017. "Study Highlights Drought and GBV Link." *Lesotho Times*, September 8. <https://lestimes.com/study-highlights-drought-and-gbv-link/>.
- 30 UNFPA. 2012. "Marrying Too Young." New York: United Nations Population Fund. <https://www.unfpa.org/publications/marrying-too-young>.
- 31 Meyer, K. et al. 2022. "Understanding the Sexual and Reproductive Health Experiences of Refugee and Host Community Adolescents and Youth in Rwanda During COVID-19: Needs, Barriers, and Opportunities." *Frontiers in Reproductive Health* 4 (March): 799699. doi:10.3389/frph.2022.799699.
- Plan International. 2019. "Sex for Food: Girls Face Impossible Choices in Southern Africa." Press release. November 4. <https://plan-international.org/news/2019/11/04/sex-for-food-girls-face-impossible-choices-in-southern-africa/>.
- Béné, C. and S. Merten. 2008. "Women and Fish-for-Sex: Transactional Sex, HIV/AIDS and Gender in African Fisheries." *World Development* 36 (5): 875–99. doi:10.1016/j.worlddev.2007.05.010.
- 32 Loevinsohn, M. 2015. "The 2001-03 Famine and the Dynamics of HIV in Malawi: A Natural Experiment." Edited by S.H. Vermund. PLOS ONE 10 (9): e0135108. doi:10.1371/journal.pone.0135108.
- Low, A.J. et al. 2019. "Association between Severe Drought and HIV Prevention and Care Behaviors in Lesotho: A Population-Based Survey 2016–2017." PLOS Medicine 16 (1): e1002727. doi:10.1371/journal.pmed.1002727.
- 33 Malala Fund. 2021. "A Greener, Fairer Future: Why Leaders Need to Invest in Climate and Girls' Education." Washington, DC: Malala Fund. <https://malala.org/newsroom/malala-fund-publishes-report-on-climate-change-and-girls-education>.
- 34 Justino, P. 2014. "Barriers to Education in Conflict-Affected Countries and Policy Opportunities." Paper commissioned for "Fixing the Broken Promise of Education for All: Findings from the Global Initiative on Out-of-School Children" (UNESCO Institute for Statistics and UNICEF, 2015). Institute of Development Studies. <https://reliefweb.int/report/world/barriers-education-conflict-affected-countries-and-policy-opportunities>.
- 35 Shenoda, S. et al. 2018. "The Effects of Armed Conflict on Children." *Pediatrics* 142 (6): e20182585. doi:10.1542/peds.2018-2585.
- 36 UNICEF. 2021. "The Climate Crisis Is a Child Rights Crisis: Introducing the Children's Climate Risk Index." New York: United Nations Children's Fund. <https://www.unicef.org/reports/climate-crisis-child-rights-crisis>.
- 37 Wehrey, F. and N. Fawal. 2022. "Cascading Climate Effects in the Middle East and North Africa: Adapting Through Inclusive Governance." Carnegie Endowment for International Peace. February 24. <https://carnegieendowment.org/2022/02/24/cascading-climate-effects-in-middle-east-and-north-africa-adapting-through-inclusive-governance-pub-86510>.
- 38 Mahlati, Z. 2022. "KZN Floods: More than 8 000 People Housed in 98 Shelters." *News24*, April 28. <https://www.news24.com/news24/southafrica/news/kzn-floods-more-than-8-000-people-housed-in-98-shelters-20220428>.
- 39 Mlaba, K. and G. Mhlungu. 2022. "How Is Apartheid's Legacy Making Climate Change Impacts Worse in South Africa?" *Global Citizen*. April 26. <https://www.globalcitizen.org/en/content/apartheid-climate-change-impact-south-africa/>.
- 40 Barnwell, 2021, "The Psychological and Mental Health Consequences of Climate Change in South Africa."
- 41 AfDB. 2020. "African Economic Outlook 2020: Developing Africa's Workforce for the Future." Abidjan, Côte d'Ivoire: African Development Bank. <https://www.afdb.org/en/documents/african-economic-outlook-2020>.
- 42 Education Commission. 2016. "The Learning Generation: Investing in Education for a Changing World." Report by the International Commission on Financing Global Education Opportunity. <https://report.educationcommission.org/downloads/>.
- 43 Education Commission and Dubai Cares. 2022. "Rewiring Education for People and Planet." <https://educationcommission.org/updates/rewiring-education-for-people-and-planet-report-calls-for-cross-sectoral-collaboration/>.
- Kamande, A. and M. Martin. 2022. "The Inequality Crisis in East Africa: Fighting Austerity and the Pandemic." Oxford, UK: Development Finance International and Oxfam. <https://policy-practice.oxfam.org/resources/the-inequality-crisis-in-east-africa-fighting-austerity-and-the-pandemic-621348/>.
- 44 UNICEF. 2021. "The Climate Crisis Is a Child Rights Crisis: Introducing the Children's Climate Risk Index."
- 45 Evans, D.K. and A. Mendez Acosta. 2021. "Education in Africa: What Are We Learning?" *Journal of African Economies* 30 (1): 13–54. doi:10.1093/jae/ejaa009.
- 46 See the Education Commission's World Skills Clock: <https://skillsclock.io>.
- 47 UNICEF. 2021. "The Climate Crisis Is a Child Rights Crisis: Introducing the Children's Climate Risk Index."
- 48 OECD. 2020. "Combatting COVID-19's Effect on Children." Tackling Coronavirus (COVID-19): Contributing to a Global Effort. Paris: Organization for Economic Co-operation and Development. <https://www.oecd.org/coronavirus/policy-responses/combating-covid-19-s-effect-on-children-2e1f3b2f/>.
- 49 Azevedo, J.P. et al. 2021. "Will Every Child Be Able to Read by 2030? Defining Learning Poverty and Mapping the Dimensions of the Challenge." Policy Research Working Paper No. 9588. Washington, DC: World Bank. <http://hdl.handle.net/10986/35300>.
- 50 UNICEF. 2021. "The Climate Crisis Is a Child Rights Crisis: Introducing the Children's Climate Risk Index."
- 51 The ND-GAIN Country Index defines vulnerability as the propensity or predisposition of human societies to be negatively impacted by climate hazards. Vulnerability is a function of unique exposure and sensitivity to climate hazards, as well as adaptive capacity to prepare and respond.
- 52 O'Neill et al., 2020, "The Effect of Education on Determinants of Climate Change Risks."
- 53 The ND-GAIN Country Index data are the latest available, for 2020 (published in July 2022); the Human Capital Data Explorer data are from Lutz, W. et al. 2018, *Demographic and Human Capital Scenarios for the 21st Century: 2018 Assessment for 201 Countries*. EUR 29113 EN. Luxembourg: Publications Office of the European Union. <https://data.europa.eu/doi/10.2760/835878>.
- 54 Adaptive capacity indicators in the ND-GAIN Country Index capture readily deployable actions to deal with sector-specific climate change impacts. For example, in the area of infrastructure, the Index addresses the country's electricity access and disaster preparedness.
- 55 The ND-GAIN Country Index data are the latest available, for 2020 (published in July 2022); the Human Capital Data Explorer data are from Lutz et al., 2018, *Demographic and Human Capital Scenarios for the 21st Century: 2018 Assessment for 201 Countries*.
- 56 See, for example, Muttarak and Lutz, 2014, "Is Education a Key to Reducing Vulnerability to Natural Disasters and Hence Unavoidable Climate Change?"; O'Neill et al., 2020, "The Effect of Education on Determinants of Climate Change Risks."
- 57 Walker, S.E. et al. 2022. "Education and Adaptive Capacity: The Influence of Formal Education on Climate Change Adaptation of Pastoral Women." *Climate and Development* 14 (5): 409–18. doi:10.1080/17565529.2021.1930508.
- Reid, A. 2019. "Climate Change Education and Research: Possibilities and Potentials versus Problems and Perils?" *Environmental Education Research* 25 (6): 767–90. doi:10.1080/13504622.2019.1664075.
- Williamson, K. et al. 2018. "Climate Change Needs Behavior Change: Making the Case for Behavior Solutions to Reduce Global Warming." Arlington, VA, US: Rare. <https://rare.org/report/climate-change-needs-behavior-change/>.
- 58 Jameel, Y. et al. 2022. "Climate—Poverty Connections: Opportunities for Synergistic Solutions at the Intersection of Planetary and Human Well-Being." Project Drawdown. doi:10.55789/y2c0k2p2.
- Baena, D. et al. 2021. "Climate Education for Women and Youth." In *Global Youth Climate Network 2021 Climate Action Position Paper*, 39–42. Washington, DC: Global Youth Climate Network. <https://y2community.org/wp-content/uploads/2022/04/GVCN-PositionPaper-2021.pdf>.
- 59 Muttarak and Lutz, 2014, "Is Education a Key to Reducing Vulnerability to Natural Disasters and Hence Unavoidable Climate Change?"
- 60 Murray, U. et al. 2016. "Smallholder Farmers and Climate Smart Agriculture: Technology and Labor-Productivity Constraints amongst Women Smallholders in Malawi." *Gender, Technology and Development* 20 (2): 117–48. doi:10.1177/0971852416640639. See also Section 9.4.5.3 in Trisos et al., 2022, "Africa."
- 61 Muttarak and Lutz, 2014, "Is Education a Key to Reducing Vulnerability to Natural Disasters and Hence Unavoidable Climate Change?"
- Lutz, W., R. Muttarak, and E. Striessnig. 2014. "Universal Education Is Key to Enhanced Climate Adaptation." *Science* 346 (6213): 1061–62. doi:10.1126/science.1257975.
- 62 Lutz, Muttarak, and Striessnig, 2014, "Universal Education Is Key to Enhanced Climate Adaptation."
- 63 While the study by Lutz et al. examined the effects of lower secondary education for girls, we take the position that girls should have access to upper secondary education as well, for a total of 12 years of basic education.
- 64 Malala Fund, 2021, "A Greener, Fairer Future: Why Leaders Need to Invest in Climate and Girls' Education."
- 65 Baena et al., 2021, "Climate Education for Women and Youth"; Walker et al., 2022, "Education and Adaptive Capacity: The Influence of Formal Education on Climate Change Adaptation of Pastoral Women."

Education *continued*

- 66 Garcia, A. et al. 2021. "Emancipatory Spaces: Opportunities for (Re)Negotiating Gendered Subjectivities and Enhancing Adaptive Capacities." *Geoforum* 119 (February): 190–205. doi:10.1016/j.geoforum.2020.09.018.
- Sultana, F. 2022. "Critical Climate Justice." *The Geographical Journal* 188 (1): 118–24. doi:10.1111/geoj.12417.
- 67 Oreta, A.W.C. 2010. "One Million Safe Schools and Hospitals Campaign: Advocacy Guide." United Nations Office for Disaster Risk Reduction, Asia and the Pacific. <https://www.undrr.org/publication/one-million-safe-schools-and-hospitals-campaign-advocacy-guide>.
- 68 Bell-Pasht, K. and D. Krechowicz. 2015. "Why Does Access to Good Climate Data Matter?" *World Meteorological Organization Bulletin* 64 (2): 17–19.
- 69 Feinstein and Mach, 2020, "Three Roles for Education in Climate Change Adaptation."
- 70 Nyiwul, L.M. 2019. "Climate Change Mitigation and Adaptation in Africa: Strategies, Synergies, and Constraints." In *Climate Change and Global Development*, edited by T. Sequeira and L. Reis, 219–41. Contributions to Economics. Cham: Springer International Publishing. doi:10.1007/978-3-030-02662-2_11.
- 71 Venter, Z.S. et al. 2020. "Green Apartheid: Urban Green Infrastructure Remains Unequally Distributed across Income and Race Geographies in South Africa." *Landscape and Urban Planning* 203 (November): 103889. doi:10.1016/j.landurbplan.2020.103889.
- Staddon, C. et al. 2018. "Contributions of Green Infrastructure to Enhancing Urban Resilience." *Environment Systems and Decisions* 38 (3): 330–38. doi:10.1007/s10669-018-9702-9.
- 72 UNESCO. 2021. "UNESCO Green Academies: Guidelines for Climate-Resilient Schools." Paris and Bangkok: United Nations Educational, Scientific and Cultural Organization. <https://unhabitat.org/unesco-green-academies-guidelines-for-climate-resilient-schools>.
- 73 Hallegette, S., J. Rentschler, and J. Rozenberg. 2019. *Lifelines: The Resilient Infrastructure Opportunity*. Sustainable Infrastructure Series. Washington, DC: World Bank. <http://hdl.handle.net/10986/31805>.
- 74 Mitra, P. and H. Vu. 2021. "Boosting Climate Responsiveness in Sub-Saharan Africa's Public Investment." *Finance & Development*, December. <https://www.imf.org/en/Publications/fandd/issues/2021/12/Africa-Boosting-Climate-Responsiveness-Sub-Saharan-Public-Investment>.
- 75 Katerere, Y. 2019. "Rethinking Our Approach to 'Built' Infrastructure and Disaster Risk Management: Lessons from Cyclone Idai." *Rights + Resources* (blog), May 22. <https://rightsandresources.org/blog/rethinking-our-approach-to-built-infrastructure-and-disaster-risk-management-lessons-from-cyclone-idai/>.
- 76 Vella-Brodrick, D.A. and K. Gilowska. 2022. "Effects of Nature (Greenspace) on Cognitive Functioning in School Children and Adolescents: A Systematic Review." *Educational Psychology Review* 34 (3): 1217–54. doi:10.1007/s10648-022-09658-5.
- 77 Dollar, E. 2017. "Seychelles Invests in Future Water Security." *World Water*.
- 78 AfDB. 2015. "Seychelles: AfDB Approves US\$ 26 million for Mahe Water Project." *African Development Bank – News and Events*. April 3. <https://www.afdb.org/pt/news-and-events/seychelles-afdb-approves-us-26-million-for-mahe-water-project-14134>.
- AfDB. 2021. "Seychelles – Country Strategy Paper 2021–2025." Abidjan, Côte d'Ivoire: African Development Bank. <https://www.afdb.org/en/documents/seychelles-country-strategy-paper-2021-2025>.
- 79 See the description of the school rainwater-harvesting project on the website of the United Nations Framework Convention on Climate Change: https://unfccc.int/files/secretariat/momentum_for_change/application/pdf/4_water_harvesting.pdf.
- 80 Nkem, J., R. Munang, and B. Pateh Jallow. 2011. "Lessons for Adaptation in Sub-Saharan Africa." CC DARE: Climate Change and Development – Adapting by Reducing Vulnerability. United Nations Environment Programme and United Nations Development Programme. <https://www.cakex.org/documents/lessons-adaptation-sub-saharan-africa>.
- See also: UNEP and UNDP. n.d. "Rainwater Harvesting in Schools: Demonstrating Adaptation to Climate Change in Schools in the Seychelles – A Summary Report." CC DARE: Climate Change and Development – Adapting by Reducing Vulnerability. United Nations Environment Programme and United Nations Development Programme. <http://www.globalislands.net/userfiles/seychelles1.pdf>.
- 81 See the description of the school garden project: https://m.facebook.com/AgricultureClimateChangeEnvironment/posts/3711036615664075?locale=ne_NP&rd_r.
- 82 Seychelles Nation. 2012. "Schools Fight Climate Change with Rainwater." January 14. <https://nation.sc/archive/233314/schools-fight-climate-change-with-rainwater>.
- 83 Gustavsson, M. 2007. "Educational Benefits from Solar Technology—Access to Solar Electric Services and Changes in Children's Study Routines, Experiences from Eastern Province Zambia." *Energy Policy* 35 (2): 1292–99. doi:10.1016/j.enpol.2006.03.019.
- 84 Goldstuck, A. 2014. "Solar-Powered Schools: Let the Sun Shine on Education." *The Mail & Guardian*, February 19. <https://mg.co.za/article/2014-02-19-solar-power-schools-let-the-sun-shine-in-on-education/>.
- 85 Dalelo, A. 2011. "A Grassroots Initiative to Disseminate Solar Energy Technologies in Ethiopia: Implications to Climate Change Education." In *Experiences of Climate Change Adaptation in Africa*, edited by W. Leal Filho, 265–80. *Climate Change Management*. Berlin, Heidelberg: Springer Berlin Heidelberg. doi:10.1007/978-3-642-22315-0_17.
- 86 See <https://www.lumos-global.com/how-solar-is-supporting-education-in-africa/>.
- 87 Tsioulou, A. et al. 2021. "A Method for Determining the Suitability of Schools as Evacuation Shelters and Aid Distribution Hubs Following Disasters: Case Study from Cagayan de Oro, Philippines." *Natural Hazards* 105 (2): 1835–59. doi:10.1007/s11069-020-04380-3.
- 88 UNESCO-UIS. 2016. "The World Needs Almost 69 Million New Teachers to Reach the 2030 Education Goals." *UIS Fact Sheet*. Paris: United Nations Educational, Scientific and Cultural Organization, Institute for Statistics. <https://unesdoc.unesco.org/ark:/48223/pf0000246124>.
- 89 Adediji, S.O. and O. Olaniyan. 2011. "Improving the Conditions of Teachers and Teaching in Rural Schools across African Countries." UNESCO International Institute for Capacity-Building in Africa, Fundamentals of Teacher Education Development No. 2. Addis Ababa: United Nations Educational, Scientific and Cultural Organization. <https://unesdoc.unesco.org/ark:/48223/pf0000216062>.
- Cliggett, L. and B. Wyssmann. 2009. "Crimes against the Future: Zambian Teachers' Alternative Income Generation and the Undermining of Education." *Africa Today* 55 (3): 25–43.
- 90 UNESCO and Education International. 2021. "Teachers Have Their Say: Motivation, Skills and Opportunities to Teach Education for Sustainable Development and Global Citizenship." Paris and Brussels: United Nations Educational, Scientific and Cultural Organization. <https://unesdoc.unesco.org/ark:/48223/pf0000379914>.
- 91 Kwauk, C. and O. Casey. 2021. "A New Green Learning Agenda: Approaches to Quality Education for Climate Action." Washington, DC: Center for Universal Education, Brookings Institution. <https://www.brookings.edu/research/a-new-green-learning-agenda-approaches-to-quality-education-for-climate-action/>.
- Monroe, M.C. et al. 2019. "Identifying Effective Climate Change Education Strategies: A Systematic Review of the Research." *Environmental Education Research* 25 (6): 791–812. doi:10.1080/13504622.2017.1360842.
- Shepardson, D.P. et al. 2012. "Conceptualizing Climate Change in the Context of a Climate System: Implications for Climate and Environmental Education." *Environmental Education Research* 18 (3): 323–52. doi:10.1080/13504622.2011.622839.
- 92 Li, C.J. et al. 2021. "Building Teachers' Self-Efficacy in Teaching about Climate Change through Educative Curriculum and Professional Development." *Applied Environmental Education & Communication* 20 (1): 34–48. doi:10.1080/1533015X.2019.1617806.
- Anyanwu, R., L. Le Grange, and P. Beets. 2015. "Climate Change Science: The Literacy of Geography Teachers in the Western Cape Province, South Africa." *South African Journal of Education* 35 (3): 1–9. doi:10.15700/saje.v35n3a1160.
- 93 Kuilen, H. van de et al. 2022. "Recontextualization of Learner-Centred Pedagogy in Rwanda: A Comparative Analysis of Primary and Secondary Schools." *Compare: A Journal of Comparative and International Education* 52 (6): 966–83. doi:10.1080/03057925.2020.1847044.
- 94 See the program website: <https://sustainabilityteachers.org>.
- 95 Strietska-Illina, O. et al. 2011. *Skills for Green Jobs: A Global View*. Geneva: International Labour Organization. http://www.ilo.org/global/publications/ilo-bookstore/order-online/books/WCMS_159585/lang-en/index.htm.
- 96 The urgent need for a more diverse and multi-sectoral workforce in education was first highlighted by the Education Commission in its Learning Generation report. It was further detailed in a subsequent flagship report: Education Commission. 2019. "Transforming the Education Workforce: Learning Teams for a Learning Generation." The Education Commission. <https://educationcommission.org/transformingtheeducationworkforce/>. See also Education Commission and Dubai Cares, 2022, "Rewiring Education for People and Planet."
- 97 Cervigni, R. et al. 2015. *Enhancing the Climate Resilience of Africa's Infrastructure: The Power and Water Sectors*. Washington, DC: World Bank. <http://hdl.handle.net/10986/21875>.
- 98 Chiriza, I., A. Matamanda, and J. Mutambwa. 2018. "Africa's Dilemmas in Climate Change Communication: Universalistic Science Versus Indigenous Technical Knowledge." In *Handbook of Climate Change Communication: Vol. 1*, edited by W. Leal Filho et al., 1–14. *Climate Change Management*. Cham: Springer International Publishing. doi:10.1007/978-3-319-69838-0_1.
- 99 Hoppers, W. and A. Yekhele. 2012. "Common Core Skills for Lifelong Learning and Sustainable Development in Africa." Paper prepared for the ADEA Triennale on Education and Training in Africa Ouagadougou, Burkina Faso February 12-17, 2012. Association for the Development of Education in Africa.
- 100 Ledley, T.S. et al. 2014. "Moving Toward Collective Impact in Climate Change Literacy: The Climate Literacy and Energy Awareness Network (CLEAN)." *Journal of Geoscience Education* 62 (3): 307–18. doi:10.5408/13-057.1.
- 101 Muttarak and Lutz, 2014, "Is Education a Key to Reducing Vulnerability to Natural Disasters and Hence Unavoidable Climate Change?"
- 102 The Human Capital Data Explorer data are from Lutz et al., 2018, *Demographic and Human Capital Scenarios for the 21st Century: 2018 Assessment for 201 Countries*. Simpson, N.P. et al. 2021. "Climate Change Literacy in Africa." *Nature Climate Change* 11 (11): 937–44. doi:10.1038/s41558-021-01171-x.
- 103 Kwauk and Casey, 2021, "A New Green Learning Agenda: Approaches to Quality Education for Climate Action."
- Pettee, A. and C. Kwauk. 2022. "Centering Youth in Green Workforce Development: An Action Guide." Unbounded Associates and Chemonics International. <https://chemonics.com/resource/centering-youth-in-green-workforce-development/>.
- 104 Rosenberg, E. et al. 2016. "Building Capacity for Green, Just and Sustainable Futures – a New Knowledge Field Requiring Transformative Research Methodology." *Journal of Education*, no. 65. doi:10.17159/165a05.
- Kronlid, D.O. and H. Lotz-Sisitka. 2014. "Transformative Learning and Individual Adaptation." In *Climate Change Adaptation and Human Capabilities*, by D.O. Kronlid, 75–105. New York: Palgrave Macmillan US. doi:10.1057/9781137428042_4.
- 105 See the CAMFED website: <https://camfed.org/us/why-girls-education/climate-action/> and also: CAMFED. 2021. "Annual Report 2020." https://camfed.org/wp-content/uploads/2021/08/CAMFED_annual_report_2020.pdf.
- 106 Reid, H. et al. 2021. "Jobs." In *State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World*, 210–35. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- 107 See the UNFCCC hub for NAPs: <https://unfccc.int/topics/adaptation-and-resilience/workstreams/national-adaptation-plans>.
- 108 Dalelo, 2011, "A Grassroots Initiative to Disseminate Solar Energy Technologies in Ethiopia: Implications to Climate Change Education."
- Lotz-Sisitka, H. 2009. "Sigtuna Think Piece 8: Piecing Together Conceptual Framings for Climate Change Education Research in Southern African Contexts." *Southern African Journal of Environmental Education* 26: 81–92. doi:10.4314/sajee.v26i0.122808.

Institutional Arrangements for Adaptation

- 1 UNFCCC. 2015. "Paris Agreement." FCCC/CP/2015/10/Add.1. Paris: United Nations Framework Convention on Climate Change. <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>.
 - 2 For an overview of NDCs and the expected updates every five years, see the UNFCCC website: <https://unfccc.int/ndc-information/nationally-determined-contributions-ndcs>.
 - 3 Fransen, T. et al. 2019. "Enhancing NDCs: A Guide to Strengthening National Climate Plans by 2020." Washington, DC: World Resources Institute and United Nations Development Programme. doi:10.46830/wriprt.19.00021.
 - 4 UNFCCC. 2022. "Reference Manual for the Enhanced Transparency Framework under the Paris Agreement." Version 2. Bonn: United Nations Framework Convention on Climate Change. <https://unfccc.int/documents/268136>.
 - 5 Sikhosana, H. 2015. "How Institutional Arrangements Can Enhance the Capacity of Developing Country Parties." Presented at a capacity-building workshop by the UNFCCC Secretariat, Bonn, October 17. https://unfccc.int/files/cooperation_and_support/capacity_building/application/pdf/how_institutional_arrangements_can_enhance_the_capacity_of_developing_country_parties.pdf.
 - 6 Fransen et al., 2019, "Enhancing NDCs: A Guide to Strengthening National Climate Plans by 2020."
 - 7 Schipper, E.L.F. et al. 2022. "Climate Resilient Development Pathways." In Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by H.-O. Pörtner et al., 2655–2807. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.
 - 8 See the UNFCCC NDC Registry: <https://unfccc.int/NDCREG>.
 - 9 Fransen et al., 2019, "Enhancing NDCs: A Guide to Strengthening National Climate Plans by 2020."
 - 10 A handful more have NAPs submitted between 2015 and 2019. See the UNFCCC NAP Registry: <https://www4.unfccc.int/sites/NAPC/Pages/national-adaptation-plans.aspx>.
 - 11 World Bank. 2021. "Climate Change Institutional Assessment." Brief. Washington, DC: World Bank. <http://hdl.handle.net/10986/35438>.
 - 12 For an overview of the CCDRs, see: <https://www.worldbank.org/en/publication/country-climate-development-reports>.
- See also the insert in this report, "The World Bank's Country Climate and Development Report for the Sahel—a Summary," for a closer look at one of these reports.
- 13 See <https://www.cadri.net>.
 - 14 See <https://www.cadri.net/cadritool/home>.
 - 15 United Republic of Tanzania. 2021. "Nationally Determined Contribution." Dodoma: Vice-President's Office. https://unfccc.int/sites/default/files/NDC/2022-06/TANZANIA_NDC_SUBMISSION_30%20JULY%202021.pdf.
 - 16 Republic of Angola. 2021. "Nationally Determined Contribution of Angola." Luanda. <https://unfccc.int/sites/default/files/NDC/2022-06/NDC%20Angola.pdf>.
 - 17 Republic of Liberia. 2021. "Liberia's Revised Nationally Determined Contribution (NDC)." Monrovia: Environment Protection Agency. https://unfccc.int/sites/default/files/NDC/2022-06/Liberia%27s%20Updated%20NDC_RL_FINAL%20%28002%29.pdf.
 - 18 Republic of Rwanda. 2020. "Updated Nationally Determined Contribution." Kigali. https://unfccc.int/sites/default/files/NDC/2022-06/Rwanda_Updated_NDC_May_2020.pdf.
 - 19 Balgah, R.A. and J.N. Kimengsi, eds. 2022. *Disaster Management in Sub-Saharan Africa: Policies, Institutions and Processes*. Bingley, UK: Emerald Publishing Ltd. doi:10.1108/9781802628173.
 - 20 United Nations. 2015. "Sendai Framework for Disaster Risk Reduction 2015–2030." Adopted at the Third UN World Conference, Sendai, Japan, March 2015. <https://www.undrr.org/implementing-sendai-framework/what-sendai-framework>.
 - UNISDR. 2005. "Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters." Extract from the final report of the World Conference on Disaster Reduction (A/CONF.206/6). Geneva: United Nations Office for Disaster Reduction. <http://www.unisdr.org/we/inform/publications/1037>.
 - 21 For an overview, see: Buchenrieder, G. 2022. "Preface." In *Disaster Management in Sub-Saharan Africa: Policies, Institutions and Processes*, edited by R.A. Balgah and J.N. Kimengsi. Bingley, UK: Emerald Publishing Ltd. doi:10.1108/9781802628173.
- See also: Buchenrieder, G., J. Brandl, and A.R. Balgah. 2021. "The Perception of Flood Risks: A Case Study of Babessi in Rural Cameroon." *International Journal of Disaster Risk Science* 12 (4): 1–21. doi:10.1007/s13753-021-00345-7.
- 22 Verhagen, J. et al. 2021. "Water Resources Management, Floods and Disaster Risk Management." In *State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World*, 388–415. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
 - 23 Gopalakrishnan, C. and N. Okada. 2007. "Designing New Institutions for Implementing Integrated Disaster Risk Management: Key Elements and Future Directions." *Disasters* 31 (4): 353–72. doi:10.1111/j.1467-7717.2007.01013.x.
 - 24 Messer, N.M. 2003. "The Role of Local Institutions and Their Interaction in Disaster Risk Mitigation: A Literature Review." Rome: Food and Agriculture Organization of the United Nations. <https://www.fao.org/publications/card/en/c/a95fc8db-d9f4-5929-9532-b686a108c42f/>.
 - 25 Gopalakrishnan and Okada, 2007, "Designing New Institutions for Implementing Integrated Disaster Risk Management: Key Elements and Future Directions."
 - 26 Republic of Malawi. 2021. "Updated Nationally Determined Contributions." Lilongwe: Ministry of Forestry and Natural Resources. <https://unfccc.int/sites/default/files/NDC/2022-06/Malawi%20Updated%20NDC%20July%202021%20submitted.pdf>.
 - 27 Republic of Malawi, 2021. "Updated Nationally Determined Contributions."

Youth and Entrepreneurship

- 1 Reid, H. et al. 2021. "Jobs." In *State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World*, 210–35. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- 2 AfDB. 2018. "Private Sector Is the Key to Africa's Green Economic Transformation." African Development Bank – News and Events. December 17. <https://www.afdb.org/en/news-and-events/private-sector-is-the-key-to-africas-green-economic-transformation-18873>.
- 3 Runde, D.F., C.M. Savoy, and J. Staguhn. 2021. "Supporting Small and Medium Enterprises in Sub-Saharan Africa through Blended Finance." CSIS Brief. Washington, DC: Center for Strategic and International Studies and Climate Investment Funds. <https://www.csis.org/analysis/supporting-small-and-medium-enterprises-sub-saharan-africa-through-blended-finance>.
- 4 International Finance Corporation, World Bank Group. (2018). *SME Finance Forum Target Solutions to Africa's US\$331 billion SME Finance Gap*. Accessed August 2022 from <https://pressroom.ifc.org/all/pages/PressDetail.aspx?ID=17513>
- 5 Reid et al., 2021, "Jobs."
- 6 Chan, S. et al. 2021. "The Private Sector." In *State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World*, 170–85. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- 7 Runde, D. F., Savoy, C. M. & Staguhn, J. 2021. Supporting Small and Medium Enterprises in Sub-Saharan Africa through Blended Finance [Brief]. Center for Strategic & International Studies
- 8 ILO. 2018. *The Employment Impact of Climate Change Adaptation*. Input Document for the G20 Climate Sustainability Working Group. ILO, Geneva
- 9 Chan et al., 2021, "The Private Sector."
- 10 UN DESA. 2022. "World Population Prospects 2022." New York: United Nations Department of Economic and Social Affairs, Population Division. <http://esa.un.org/unpd/wpp/>. Custom data accessed via website.
- 11 Fox, L. and Y. El Amine. 2021. "Youth." In *State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World*, 186–209. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- AfDB. 2016. "Jobs for Youth in Africa: Catalyzing Youth Opportunity across Africa." Abidjan: African Development Bank. https://www.afdb.org/fileadmin/uploads/afdb/Images/high_5s/Job_youth_Africa_Job_youth_Africa.pdf.
- AfDB et al. 2012. *African Economic Outlook 2012: Promoting Youth Employment*. Paris: African Development Bank, Organisation for Economic Co-operation and Development, United Nations Development Programme and United Nations Economic Commission for Africa. <https://doi.org/10.1787/aao-2012-en>.
- 12 Fox and El Amine, 2021, "Youth."
- 13 Chan et al., 2021, "The Private Sector"; Fox and El Amine, 2021, "Youth."
- 14 See the ThinkHazard! Page on river flood risks in Cameroon: <https://www.thinkhazard.org/en/report/45-cameroon/FL> (data last updated September 2020).
- 15 World Food Programme. 2022. *WFP Zambia Country Brief*, June 2022. <https://docs.wfp.org/api/documents/WFP-0000141361/download/?ga=2.234528222.1397038414.1659034693-763161054.1659034693>.
- 16 See the ThinkHazard! Risk profile for Northern Ghana: <https://www.thinkhazard.org/en/report/1329-ghana-northern> (data last updated June 2021).
- 17 World Bank. 2021. "Climate Risk Country Profile: Nigeria." Washington, DC: World Bank Group. https://climateknowledgeportal.worldbank.org/sites/default/files/2021-07/15918-WB_Nigeria%20Country%20Profile-WEB.pdf.
- 18 See ThinkHazard! risk profile for Nigeria: <https://www.thinkhazard.org/en/report/182-nigeria> (data last updated August 2020).
- 19 Sogbanmu, T.O. 2022. "Plastic Pollution in Nigeria Is Poorly Studied but Enough Is Known to Urge Action." *The Conversation* (blog), June 27. <http://theconversation.com/plastic-pollution-in-nigeria-is-poorly-studied-but-enough-is-known-to-urge-action-184591>. See also this Salubata profile: <https://fortomorrow.org/explore-solutions/salubata>.
- 20 World Bank. 2021. "Climate Risk Country Profile: Kenya." Washington, DC: World Bank Group. https://climateknowledgeportal.worldbank.org/sites/default/files/2021-05/15724-WB_Kenya%20Country%20Profile-WEB.pdf.
- 21 See, for example: Mbuli, C.S., L.N. Fonjong, and A.J. Fletcher. 2021. "Climate Change and Small Farmers' Vulnerability to Food Insecurity in Cameroon." *Sustainability* 13 (3). Multidisciplinary Digital Publishing Institute: 1523. doi:10.3390/su13031523.
- 22 Hunter, R. et al. 2020. "Research Highlights – Climate Change and Future Crop Suitability in Zambia." Research by the University of Cape Town, South Africa, in support of IFAD's Adaptation for Smallholder Agriculture Programme (ASAP), Phase 2. Rome: International Fund for Agricultural Development. https://www.ifad.org/documents/38714170/42164624/climate_analysis_zambia.pdf.
- 23 World Bank, 2021, "Climate Risk Country Profile: Kenya."

Security

- 1 Werrell, C. and F. Femia. 2019. "The Responsibility to Prepare and Prevent: A Climate Security Governance Framework for the 21st Century." Washington, DC: The Center for Climate and Security. <https://climateandsecurity.org/the-responsibility-to-prepare-and-prevent-a-climate-security-governance-framework-for-the-21st-century/>.
- 2 Obama, B. 2009. "Remarks by the President at UN Secretary General Ban Ki Moon's Climate Change Summit." September 22. <https://obamawhitehouse.archives.gov/the-press-office/remarks-president-un-secretary-general-ban-ki-moons-climate-change-summit>.
- 3 See the overview of climate change and security risks provided by the United Nations Environment Programme (UNEP) on its website: <https://www.unep.org/explore-topics/disasters-conflicts/what-we-do/disaster-risk-reduction/climate-change-and-security>.
- 4 This term, widely used now, first emerged among security experts. See: CNA Military Advisory Board. 2007. "National Security and the Threat of Climate Change." Arlington, VA, US: The CNA Corporation. <https://www.cna.org/reports/2007/national-security-and-the-threat-of-climate-change>. See also: United Nations. 2019. "Climate Change Recognized as 'Threat Multiplier', UN Security Council Debates Its Impact on Peace." January 25. <https://news.un.org/en/story/2019/01/1031322>.
- 5 These dynamics were also addressed in last year's State and Trends report. See El Amine, Y. 2021. "Conflict and Migration." In State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World, 448–67. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>. See also FAQ 7.3 (p. 1128) and Sections 7.2 and 7.3 in: Cissé, G. et al. 2022. "Health, Wellbeing and the Changing Structure of Communities." In Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by H.-O. Pörtner et al., 1041–1170. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.
- 6 See, for example: Lenshie, N.E. et al. 2022. "Geopolitics of Climate Change-Induced Conflict and Population Displacement in West Africa." *Local Environment* 27 (3): 287–308. doi:10.1080/13549839.2022.2040461.
- 7 The Notre Dame Global Adaptation Initiative's Country Index measures a wide range of factors that contribute to countries' vulnerability to climate change and to their ability to respond effectively. It includes separate scores for vulnerability and for readiness, and then combines them into a single ranking. The 10 bottom-ranked countries for 2020 (out of 182 ranked, listed here from the bottom up) are Chad, the Central African Republic, Guinea-Bissau, Eritrea, the Democratic Republic of the Congo, Sudan, Niger, Afghanistan, Zimbabwe, and Liberia. Note that South Sudan is not ranked. The Stockholm International Peace Institute's 2022 Yearbook identifies "high-intensity armed conflicts" with 1,000–9,999 conflict-related deaths in 12 African countries in 2021: Nigeria, Ethiopia, the Democratic Republic of the Congo, Somalia, Burkina Faso, South Sudan, Mali, Sudan, the Central African Republic, Niger, Cameroon, and Mozambique. See: Davis, I. and C. Pfeifer Cruz. 2022. "Global Developments in Armed Conflicts, Peace Processes and Peace Operations." In SIPRI Yearbook 2022: Armaments, Disarmament and International Security. Solna, Sweden, and London: Stockholm International Peace Research Institute and Oxford University Press. <https://www.sipri.org/yearbook/2022/02>. See also the Council on Foreign Relations' Global Conflict Tracker: <https://www.cfr.org/global-conflict-tracker> and the Armed Conflict Location & Event Data Project (ACLED) dashboard, which provides more granular data on smaller conflicts as well: <https://acleddata.com/dashboard/#/dashboard>.
- 8 See Box 9.9 in Trisos, C.H. et al. 2022. "Africa." In Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by H.-O. Pörtner et al., 1285–1455. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.
- 9 See discussion in El Amine, 2021, "Conflict and Migration." See also Box 9.9 in Trisos et al., 2022, "Africa," and the extensive literature cited therein.
- 10 See discussion in El Amine, 2021, "Conflict and Migration." See also: Brottem, L. 2021. "The Growing Complexity of Farmer-Herder Conflict in West and Central Africa." *Africa Security Brief* No. 39. Washington, DC: Africa Center for Strategic Studies. <https://africacenter.org/publication/growing-complexity-farmer-herder-conflict-west-central-africa/>.
- 11 See Box 1 and Figure 2 in El Amine, 2021, "Conflict and Migration."
- 12 Sweijts, T., M. de Haan, and H. van Manen. 2022. "Unpacking the Climate Security Nexus: Seven Pathologies Linking Climate Change to Violent Conflict." The Hague: The Hague Institute for Global Justice. <https://hccs.nl/report/unpacking-the-climate-security-nexus/>.
- 13 Sweijts, de Haan, and van Manen, 2022, "Unpacking the Climate Security Nexus: Seven Pathologies Linking Climate Change to Violent Conflict."
- 14 Mayans, J. 2020. "The Sahel in the Midst of Climate Change." *Solidarités International* blog. March 16. <https://www.solidarites.org/en/live-from-the-field/the-sahel-in-the-midst-of-climate-change/>.
- 15 Hussona, J. 2021. "How Is Climate Change Driving Conflict in Africa?" *Action on Armed Violence* blog. March 10. <https://aaav.org.uk/2021/how-is-climate-change-driving-conflict-in-africa/>.
- 16 Sweijts, de Haan, and van Manen, 2022, "Unpacking the Climate Security Nexus: Seven Pathologies Linking Climate Change to Violent Conflict."
- 17 NUPI and SIPRI. 2021. "Climate, Peace and Security Fact Sheet: Somalia." Oslo and Solna, Sweden: Norwegian Institute of International Affairs and Stockholm International Peace Research Institute. <https://www.nupi.no/en/news/climate-peace-and-security-fact-sheet-somalia>.
- 18 Freeman, L. 2017. "Environmental Change, Migration, and Conflict in Africa: A Critical Examination of the Interconnections." *The Journal of Environment & Development* 26 (4): 351–74. doi:10.1177/1070496517727325.
- 19 USAID. 2014. "Climate Change and Conflict in the Sahel." Washington, DC: U.S. Agency for International Development. <https://www.climatelinks.org/resources/climate-change-and-conflict-sahel>.
- 20 Lenshie et al., 2022, "Geopolitics of Climate Change-Induced Conflict and Population Displacement in West Africa."
- 21 Freeman, 2017, "Environmental Change, Migration, and Conflict in Africa: A Critical Examination of the Interconnections."
- 22 Freeman, 2017, "Environmental Change, Migration, and Conflict in Africa: A Critical Examination of the Interconnections."
- 23 Mbaye, A.A. and L. Signé. 2022. "Political Turmoil in the Sahel: Does Climate Change Play a Role?" *Brookings Institution. Africa in Focus* (blog), March 11. <https://www.brookings.edu/blog/africa-in-focus/2022/03/11/political-turmoil-in-the-sahel-does-climate-change-play-a-role/>.
- 24 Killelea, S. 2021. "Conflict in the Sahel Likely to Worsen as Climate Change Impacts Increase." *Wilson Center. New Security Beat* (blog), September 7. <https://www.newsecuritybeat.org/2021/09/conflict-sahel-worsen-climate-change-impacts-increase/>.
- 25 Tarif, K. and A.O. Grand. 2021. "Climate Change and Violent Conflict in Mali." *ACCORD. Conflict & Resilience Monitor* (blog), June 10. <https://www.accord.org.za/analysis/climate-change-and-violent-conflict-in-mali/>.
- 26 Mbiyozo, A.-N. and O.A. Maunganzidze. 2021. "Climate Change and Violence in Africa: No Time to Lose." *Institute for Security Studies. ISS Today* (blog), May 17. <https://issafrica.org/iss-today/climate-change-and-violence-in-africa-no-time-to-lose>. Caus, J. and S. O'Neil. 2021. "Climate Change Is Fueling Recruitment into Armed Groups." *United Nations University. Our World* (blog), March 8. <https://ourworld.unu.edu/en/climate-change-is-fueling-recruitment-into-armed-groups>.
- 27 Lenshie et al., 2022, "Geopolitics of Climate Change-Induced Conflict and Population Displacement in West Africa."
- 28 ICG. 2020. "The Central Sahel: Scene of New Climate Wars?" *Africa Briefing* No. 154. International Crisis Group. <https://www.crisisgroup.org/africa/sahel/b154-le-sahel-central-theatre-des-nouvelles-guerres-climatiques>.
- 29 Mbiyozo and Maunganzidze, 2021, "Climate Change and Violence in Africa: No Time to Lose."
- 30 Sweijts, T. and J. Teer. 2022. "Practices, Principles and Promises of Conflict Early Warning Systems." The Hague: The Hague Institute for Global Justice. <https://hccs.nl/report/practices-principles-and-promises-of-conflict-early-warning-systems/>.
- 31 Sweijts and Teer, 2022, "Practices, Principles and Promises of Conflict Early Warning Systems."
- 32 See also: Lenton, T.M. 2020. "Tipping Positive Change." *Philosophical Transactions of the Royal Society B: Biological Sciences* 375 (1794): 20190123. doi:10.1098/rstb.2019.0123.
- 33 Sweijts and Teer, 2022, "Practices, Principles and Promises of Conflict Early Warning Systems."
- 34 Malekovic, N. et al. 2022 (forthcoming). "Angling for Causality Behind Security." The Hague: The Hague Institute for Global Justice. <https://hccs.nl/research/>.
- 35 Sweijts and Teer, 2022, "Practices, Principles and Promises of Conflict Early Warning Systems."
- 36 Sweijts, de Haan, and van Manen, 2022, "Unpacking the Climate Security Nexus: Seven Pathologies Linking Climate Change to Violent Conflict."
- 37 ECOWAS. 2019. "ECOWAS and Scientific Community Assess ECOWARN System | Economic Community of West African States (ECOWAS)." *Economic Community of West African States*. October 14. <https://ecowas.int/?p=36121>.
- 38 Sweijts and Teer, 2022, "Practices, Principles and Promises of Conflict Early Warning Systems."
- 39 Sweijts and Teer, 2022, "Practices, Principles and Promises of Conflict Early Warning Systems."
- 40 Gnanouenon, A. 2021. "Pivoting to African Conflict Prevention?" *Brief* No. 3/2021. Paris: European Union Institute for Security Studies. <https://www.iss.europa.eu/content/pivoting-african-conflict-prevention>.
- 41 Sweijts and Teer, 2022, "Practices, Principles and Promises of Conflict Early Warning Systems."
- 42 Sweijts and Teer, 2022, "Practices, Principles and Promises of Conflict Early Warning Systems."
- 43 Sweijts and Teer, 2022, "Practices, Principles and Promises of Conflict Early Warning Systems."
- 44 Chojnacki, S., M. Herchenbach, and G. Reisch. 2009. "Perspectives on War: Disentangling Distinct Phenomena: Wars and Military Interventions, 1990-2008." *Sicherheit & Frieden* 27 (4): 242–51. doi:10.5771/0175-274x-2009-4-242.
- 45 Twigg, J. 2021. "Sustainability of Early Warning Systems." *Building Resilience and Adapting to Climate Change Discussion Paper*. London: Overseas Development Institute. <https://bracc.kulima.com/resource/sustainability-early-warning-systems.html>.
- 46 Sweijts and Teer, 2022, "Practices, Principles and Promises of Conflict Early Warning Systems."
- 47 Crawford, A. and C. Church. 2020. "The NAP Process and Peacebuilding." *NAP Global Network Briefing Note*. Winnipeg: International Institute for Sustainable Development. <https://naglobalnetwork.org/resource/naps-and-peacebuilding/>.
- 48 Cao, Y. et al. 2021. "Exploring the Conflict Blind Spots in Climate Adaptation Finance." *Supporting Pastoralism and Agriculture in Recurrent and Protracted Crises (SPARC) Synthesis Report*. London: Overseas Development Institute. <https://www.sparc-knowledge.org/resources/synthesis-report-exploring-conflict-blind-spots-climate-adaptation-finance>.
- 49 République du Mali. 2021. "Contribution Déterminée Au Niveau National Révisée." Bamako: Ministère de l'Environnement, de l'Assainissement et du Développement Durable. <https://unfccc.int/sites/default/files/NDC/2022-06/MALI%20First%20NDC%20update.pdf>.
- 50 République du Mali. 2007. "Programme d'Action National d'Adaptation Aux Changements Climatiques." Bamako: Ministère de l'Équipement et des Transports. <https://unfccc.int/resource/docs/napa/mli01f.pdf>.

Security
continued

- 51 Marketing in this context refers to the entire process to produce, promote and price a commodity. Sitati, A. et al. 2021. "Climate Change Adaptation in Conflict-Affected Countries: A Systematic Assessment of Evidence." *Discover Sustainability* 2 (1): 42. doi:10.1007/s43621-021-00052-9.
- 52 Cao et al., 2021, "Exploring the Conflict Blind Spots in Climate Adaptation Finance."
- 53 Cao et al., 2021, "Exploring the Conflict Blind Spots in Climate Adaptation Finance."
- 54 Eriksen, S. et al. 2021. "Adaptation Interventions and Their Effect on Vulnerability in Developing Countries: Help, Hindrance or Irrelevance?" *World Development* 141 (May): 105383. doi:10.1016/j.worlddev.2020.105383.
- 55 For a review of experiences with NAPAs in South Asia, see: Sultana, P. et al. 2019. "Transforming Local Natural Resource Conflicts to Cooperation in a Changing Climate: Bangladesh and Nepal Lessons." *Climate Policy* 19 (sup1): S94–106. doi:10.1080/14693062.2018.1527678.
- 56 For an in-depth discussion, see this 2014 ACCORD book: Bob, U. and S. Bronkhorst, eds. 2014. *Conflict-Sensitive Adaptation to Climate Change in Africa*. Durban: African Centre for the Constructive Resolution of Disputes. <https://www.accord.org.za/publication/conflict-sensitive-adaptation-to-climate-change-in-africa/>.
- 57 Davison, W. 2011. "Ethiopia Plans Ambitious Resettlement of People Buffeted by East Africa Drought." *The Christian Science Monitor*, August 1. <https://www.csmonitor.com/World/Africa/2011/0801/Ethiopia-plans-ambitious-resettlement-of-people-buffed-by-East-Africa-drought>.
- 58 Fleishman, R. 2022. "Climate Change, Security, and Political Coherence in the South and East China Seas: A Scenarios-Based Assessment." Washington, DC: The Center for Climate and Security. https://climateandsecurity.org/wp-content/uploads/2022/04/Climate-Change-Security-and-Political-Coherence-in-the-South-and-East-China-Seas_April-2022.pdf.
- 59 See <https://waterpeacesecurity.org/info/our-approach>.
- 60 WPS. 2022. "WPS Global Early Warning Tool February 2022 Quarterly Analysis." Water, Peace and Security Partnership. February 3. <https://waterpeacesecurity.org/info/global-tool-update-february-2022>.
- 61 See <https://waterpeacesecurity.org>.
- 62 See the WPS Kenya information page: <https://waterpeacesecurity.org/info/kenya>.
- 63 See the WPS web page on tailored learning: <https://waterpeacesecurity.org/info/tailored-learning>.
- 64 See the WPS Mali information page: <https://waterpeacesecurity.org/info/mali>.
- 65 Ferris, E. 2012. "Future Directions in Civil-Military Responses to Natural Disasters." Australian Civil-Military Centre Research and Lessons Learned Program, Paper 05/2012. Washington, DC: Brookings Institution. <https://www.brookings.edu/research/future-directions-in-civil-military-responses-to-natural-disasters/>.
- 66 Werrell and Femia, 2019, "The Responsibility to Prepare and Prevent: A Climate Security Governance Framework for the 21st Century."
- 67 Aminga, V.M. and F. Krampe. 2020. "Climate-Related Security Risks and the African Union." SIPRI Policy Brief. Solna, Sweden: Stockholm International Peace Research Institute. <https://sipri.org/publications/2020/sipri-policy-briefs/climate-related-security-risks-and-african-union>.
- 68 UN Security Council. 2020. "Proposed Mandate for the United Nations Office for West Africa and the Sahel." New York: United Nations. https://unowas.unmissions.org/sites/default/files/s_2020_85.pdf.
- 69 Brock, S. et al. 2021. *The World Climate and Security Report 2021*. Edited by E. Sikorsky and F. Femia. Washington, DC: The Center for Climate and Security. <https://imccs.org/the-world-climate-and-security-report-2021/>.
- 70 Coning, C.H. de and F. Krampe. 2020. "Multilateral Cooperation in the Area of Climate-Related Security and Development Risks in Africa." NUPI Report 4/2020. Oslo: Norwegian Institute of International Affairs and Stockholm International Peace Research Institute. <https://www.nupi.no/en/publications/cristin-pub/multilateral-cooperation-in-the-area-of-climate-related-security-and-development-risks-in-africa>.
- 71 Amu, N. 2020. "Addressing Climate Change-Related Security Risks: The Experience of a Regional Special Political Mission." Issue Brief No. 18/2020. UNDP Oslo Governance Centre and Folke Bernadotte Academy. https://www.undp.org/sites/g/files/zskgke326/files/migration/oslo_governance_centre/3997d7381d0e3a90b20f4113b189114de7db009e2cc2343218844c35dbaeef0f.pdf.
- 72 Brock et al., 2021, *The World Climate and Security Report 2021*.
- 73 Aminga and Krampe, 2020, "Climate-Related Security Risks and the African Union."
- 74 African Union. 2018. "Continental Structural Conflict Prevention Framework." Addis Ababa: Peace and Security Department. <https://www.peaceau.org/uploads/01-cscpf-booklet-updated-final.pdf>.
- 75 Aminga and Krampe, 2020, "Climate-Related Security Risks and the African Union."

Migration and Climate Change

- 1 Trisos, C.H. et al. 2022. "Africa." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by H.-O. Pörtner et al., 1285–1455. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.
- 2 El Amine, Y. 2021. "Conflict and Migration." In *State and Trends in Adaptation Report 2021: How Adaptation Can Make Africa Safer, Greener and More Prosperous in a Warming World*, 448–67. Rotterdam: Global Center on Adaptation. <https://gca.org/reports/state-and-trends-in-adaptation-report-2021/>.
- 3 Rigaud, K.K. et al. 2018. "Groundswell: Preparing for Internal Climate Migration." Washington, DC: World Bank. <http://hdl.handle.net/10986/29461>.
- 4 Clement, V. et al. 2021. "Groundswell Part 2: Acting on Internal Climate Migration." Washington, DC: World Bank. <http://hdl.handle.net/10986/36248>.
- 5 Clement et al., 2021, "Groundswell Part 2: Acting on Internal Climate Migration."
- 6 Climate out-migration hotspots are areas that will see decreases in population in scenarios that consider climate change impacts relative to a population projection that does not take climate change impacts into account. These increases can be attributed to out-migration. The areas were considered to have decreases in population when at least two of the three scenarios modeled had reductions in population density in the highest 10th percentile of the distribution (for North Africa and Morocco) and in the highest 5th percentile of the distribution (West Africa, Nigeria, Senegal, Lake Victoria Basin, Uganda, and Tanzania).
- 7 Climate in-migration hotspots are areas that will see increases in population in scenarios that consider climate change impacts relative to a population projection that does not take climate change impacts into account. These increases can be attributed to in-migration. Areas were considered to have population increases when at least two of the three scenarios modeled had increases in population density in the highest 10th percentile of the distribution (for North Africa and Morocco) and in the highest 5th percentile of the distribution (West Africa, Nigeria, Senegal, Lake Victoria Basin, Uganda, and Tanzania).
- 8 Clement et al., 2021, "Groundswell Part 2: Acting on Internal Climate Migration"; Rigaud, K.K. et al. 2021. "Groundswell Africa: Internal Climate Migration in West African Countries." Washington, DC: World Bank. <http://hdl.handle.net/10986/36404>.
- 9 Ellis, E.C. et al. 2010. "Anthropogenic Transformation of the Biomes, 1700 to 2000." *Global Ecology and Biogeography* 19 (5): 589–606. doi:10.1111/j.1466-8238.2010.00540.x.
- 10 Rigaud, K.K. et al. 2021. "Groundswell Africa: Internal Climate Migration in the Lake Victoria Basin Countries." Washington, DC: World Bank. <http://hdl.handle.net/10986/36403>.
- Rigaud, K.K. et al. 2021. "Groundswell Africa: A Deep Dive on Internal Climate Migration in Tanzania." Washington, DC: World Bank. <http://hdl.handle.net/10986/36446>.
- Rigaud, K.K. et al. 2021. "Groundswell Africa: A Deep Dive Into Internal Climate Migration in Uganda." Washington, DC: World Bank. <http://hdl.handle.net/10986/36447>.
- 11 "Rigaud et al., 2021, "Groundswell Africa: Internal Climate Migration in the Lake Victoria Basin Countries."
- 12 Rigaud et al., 2021, "Groundswell Africa: A Deep Dive on Internal Climate Migration in Tanzania."
- 13 Based on an aggregation of anthropogenic biomes produced by Ellis and others. See: Ellis et al., 2010, "Anthropogenic Transformation of the Biomes, 1700 to 2000."
- Ellis, E.C. et al. 2013. "Used Planet: A Global History." *Proceedings of the National Academy of Sciences* 110 (20): 7978–85. doi:10.1073/pnas.1217241110.
- 14 Rigaud et al., 2021, "Groundswell Africa: A Deep Dive Into Internal Climate Migration in Uganda."
- 15 Twinomuhangi, R. et al. 2022. "Assessing The Evidence: Migration, Environment & Climate Change Nexus in Uganda." doi:10.13140/RG.2.2.28791.70561.
- 16 Rigaud et al., 2021, "Groundswell Africa: Internal Climate Migration in West African Countries."
- 17 Rigaud et al., 2021, "Groundswell Africa: Internal Climate Migration in West African Countries." Washington, DC: World Bank. <http://hdl.handle.net/10986/36404>.
- Rigaud et al., 2021, "Groundswell Africa: Deep Dive into Internal Climate Migration in Senegal." Washington, DC: World Bank.
- Rigaud et al., 2021, "Groundswell Africa: Deep Dive into Internal Climate Migration in Nigeria." Washington, DC: World Bank.
- 18 Rigaud et al., 2021, "Groundswell Africa: Internal Climate Migration in West African Countries."

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- 1 IPCC. 2022. "Summary for Policymakers." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by H.-O. Pörtner et al. Cambridge, UK, and New York: Cambridge University Press (in press). <https://www.ipcc.ch/report/ar6/wg2/>.
- Oppenheimer, M. et al. 2014. "Emergent Risks and Key Vulnerabilities." In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change*, edited by C.B. Field et al., 1039–99. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar5/wg2/>.
- 2 Damania, R. et al. 2017. *Uncharted Waters: The New Economics of Water Scarcity and Variability*. Washington, DC: World Bank. doi:10.1596/978-1-4648-1179-1.
- 3 IPCC. 2019. *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*. Edited by P.R. Shukla et al. Revised by the IPCC in January 2020. Geneva: Intergovernmental Panel on Climate Change. <https://www.ipcc.ch/srcc/>.
- 4 IPCC. 2007. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007*. Edited by M.L. Parry et al. Cambridge, UK, and New York: Cambridge University Press. <http://www.ipcc.ch/report/ar4/wg2/>.
- 5 Trisos, C.H. et al. 2022. "Africa." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by H.-O. Pörtner et al., 1285–1455. Cambridge, UK, and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg2/>.
- IPCC. 2007. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007*. Edited by M.L. Parry et al. Cambridge, UK, and New York: Cambridge University Press. <http://www.ipcc.ch/report/ar4/wg2/>.
- 6 IPCC. 2022. "Annex II: Glossary." In *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by H.-O. Pörtner et al., 2897–2930. Cambridge, UK, and New York: Cambridge University Press. doi:10.1017/9781009325844.029.
- 7 Lall, S.V., J.V. Henderson, and A.J. Venables. 2017. *Africa's Cities: Opening Doors to the World*. Washington, DC: World Bank. <http://hdl.handle.net/10986/25896>.
- 8 Adger, W.N. 2009. "Social Capital, Collective Action, and Adaptation to Climate Change." *Economic Geography* 79 (4): 387–404. doi:10.1111/j.1944-8287.2003.tb00220.x.
- 9 Valkengoed, A. van and L. Steg. 2019. *The Psychology of Climate Change Adaptation. Elements in Applied Social Psychology*. Cambridge, UK: Cambridge University Press. <https://www.cambridge.org/core/elements/psychology-of-climate-change-adaptation/F754A13BC739278F87346912664E552E>.
- 10 Fankhauser, S. 2017. "Adaptation to Climate Change." *Annual Review of Resource Economics* 9 (1): 209–30. doi:10.1146/annurev-resource-100516-033554.
- 11 Collier, P., G. Conway, and T. Venables. 2008. "Climate Change and Africa." *Oxford Review of Economic Policy* 24 (2): 337–53. doi:10.1093/oxrep/grn019.
- Hallegatte, S. et al. 2016. *Shock Waves: Managing the Impacts of Climate Change on Poverty. Climate Change and Development. Climate Change and Development*. Washington, DC: World Bank. doi:10.1596/978-1-4648-0673-5_fm.
- 12 Fankhauser. 2017.
- 13 Millner, A. and S. Dietz. 2015. "Adaptation to Climate Change and Economic Growth in Developing Countries." *Environment and Development Economics* 20 (3). Cambridge University Press: 380–406. doi:10.1017/S1355770X14000692.
- 14 Conway, D. 2011. "Adapting Climate Research for Development in Africa." *WIREs Climate Change* 2 (3): 428–50. doi:10.1002/wcc.115.