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# Using the Past to Inform a Sustainable Future: Palaeoecological Insights from East Africa

Africa and the Sustainable Development Goals pp

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Chapter

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## Abstract

An important aspect of the UN Framework Convention on Climate Change (UNFCCC), which aims to limit the increase in global temperature to 1.5 °C by 2050, has been the development of monitoring and evaluation plans that integrate climate change perspectives into new policies and programs for the protection and functioning of ecological systems. These include measures that enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change. Ecosystem change and the interaction of the different drivers of change in ecosystems have been studied at different temporal and spatial scales across different disciplines. However, the use of long temporal records documenting environmental and climatic change in understanding the impacts of the interacting drivers of change and planning sustainable use of resources is relatively new. We present examples of the use of palaeoecological data from East Africa in planning for the long-term sustainable use of natural resources by providing long-term historical perspectives on human–environment–societal–wildlife interactions and engagement with the biocultural heritage and societal evaluations of these spaces to achieve an increasingly diverse set of conservation, social and economic objectives. We link the Earth system processes whose associated boundaries can be directly related to sustainable development goals in our attempt to prevent unacceptable environmental change. The realisation that humans are having a significant impact on climate and landscapes means we now need to showcase the societal relevance of palaeoecological research and utilise its output especially in our efforts to remain within a safe operating space for humanity and ecosystems.

## Keywords

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## References

- Biginagwa TJ (2012) Historical archaeology of the 19th century caravan trade in North-Eastern Tanzania: a zooarchaeological perspective. University of York [Google Scholar](#) (<https://scholar.google.com/scholar?q=Biginagwa%20TJ%20%282012%29%20Historical%20archaeology%20of%20the%2019th%20century%20caravan%20trade%20in%20North-Eastern%20Tanzania%3A%20a%20zooarchaeological%20perspective.%20University%20of%20York>)
- Boko M et al (2007) Africa. climate change 2007: impacts, adaptation and vulnerability. In: Contribution of working Group II to the fourth assessment report of the intergovernmental panel on climate change. pp 433–467 [Google Scholar](#) (<https://scholar.google.com/scholar?q=Boko%20M%20et%20al%20%282007%29%20Africa.%20climate%20change%202007%3A%20impacts%20and%20adaptation%20and%20vulnerability.%20In%3A%20Contribution%20of%20working%20Group%20II%20to%20the%20fourth%20assessment%20report%20of%20the%20intergovernmental%20panel%20on%20climate%20change.%20pp%20433%E2%80%93467>)
- Brockington D, Sachedina H, Scholfield K (2008) Preserving the new Tanzania: conservation and land use. *Int J Afr Hist Stud* 41(3):557–579 [Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Preserving%20the%20new%20Tanzania%3A%20conservation%20and%20land%20use&author=D.%20Brockington&author=H.%20Sachedina&author=K.%20Scholfield&journal=Int%20J%20Afr%20Hist%20Stud&volume=41&issue=3&pages=557-579&publication\\_year=2008](http://scholar.google.com/scholar_lookup?title=Preserving%20the%20new%20Tanzania%3A%20conservation%20and%20land%20use&author=D.%20Brockington&author=H.%20Sachedina&author=K.%20Scholfield&journal=Int%20J%20Afr%20Hist%20Stud&volume=41&issue=3&pages=557-579&publication_year=2008))
- Burnett AP, Soreghan MJ, Scholz CA, Brown ET (2011) Tropical East African climate change and its relation to global climate: a record from Lake Tanganyika, Tropical East Africa, over the past 90 + kyr. *Palaeogeogr Palaeoclimatol Palaeoecol* 303(1–4):155–167 [CrossRef](#) (<https://doi.org/10.1016/j.palaeo.2010.02.011>) [Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Tropical%20East%20African%20climate%20change%20and%20its%20relation%20to%20global%20climate%3A%20a%20record%20from%20Lake%20Tanganyika%2C%20Tropical%20East%20Africa%2C%20over%20the%20past%2090%E2%80%89%28%29%20kyr&author=AP.%20Burnett&author=MJ.%20Soreghan&author=CA.%20Scholz&author=ET.%20Brown&journal=Palaeogeogr%20Palaeoclimatol%20Palaeoecol&volume=303&issue=1%E2%80%93167&publication\\_year=2011](http://scholar.google.com/scholar_lookup?title=Tropical%20East%20African%20climate%20change%20and%20its%20relation%20to%20global%20climate%3A%20a%20record%20from%20Lake%20Tanganyika%2C%20Tropical%20East%20Africa%2C%20over%20the%20past%2090%E2%80%89%28%29%20kyr&author=AP.%20Burnett&author=MJ.%20Soreghan&author=CA.%20Scholz&author=ET.%20Brown&journal=Palaeogeogr%20Palaeoclimatol%20Palaeoecol&volume=303&issue=1%E2%80%93167&publication_year=2011))
- Cohen AS, Stone JR, Beuning KR, Park LE, Reinthal PN, Dettman D, Scholz CA, Johnson TC, King JW, Talbot MR, Brown ET (2007) Ecological consequences of early Late Pleistocene megadroughts in tropical Africa. *Proc Natl Acad Sci*

104(42):16422–16427

[CrossRef](https://doi.org/10.1073/pnas.0703873104) (https://doi.org/10.1073/pnas.0703873104)

[Google Scholar](http://scholar.google.com) (http://scholar.google.com

/scholar\_lookup?title=Ecological%20consequences%20of%20early%20Late%20Pleistocene%20megadroughts%20in%20tropical%20Africa&author=AS.%20Cohen&author=JR.%20Stone&author=KR.%20Beuning&author=LE.%20Park&author=PN.%20Reinthal&author=D.%20Dettman&author=CA.%20Scholz&author=TC.%20Johnson&author=JW.%20King&author=MR.%20Talbot&author=ET.%20Brown&journal=Proc%20Nat%20Acad%20Sci&volume=104&issue=42&pages=16422-16427&publication\_year=2007)

Cole LES, Bhagwat S, Willis KJ (2014) Recovery and resilience of tropical forests after disturbance. *Nat Commun Nat Pub Group* 5(May):3906. <https://doi.org/10.1038/ncomms4906> (https://doi.org/10.1038/ncomms4906)

[CrossRef](https://doi.org/10.1038/ncomms4906) (https://doi.org/10.1038/ncomms4906)

[Google Scholar](http://scholar.google.com) (http://scholar.google.com

/scholar\_lookup?title=Recovery%20and%20resilience%20of%20tropical%20forests%20after%20disturbance&author=LES.%20Cole&author=S.%20Bhagwat&author=KJ.%20Willis&journal=Nat%20Commun%20Nat%20Pub%20Group&volume=5&issue=May&pages=3906&publication\_year=2014&doi=10.1038/ncomms4906)

Corvalan C, Hales S, McMichael A (2005) Ecosystems and human well-being, millenium ecosystem assessment. *Ecosystems and human well-being: health synthesis*, Geneva. <https://doi.org/10.1088/1751-8113/44/8/085201> (https://doi.org/10.1088/1751-8113/44/8/085201)

[CrossRef](https://doi.org/10.1088/1751-8113/44/8/085201) (https://doi.org/10.1088/1751-8113/44/8/085201)

[Google Scholar](http://scholar.google.com/scholar_lookup?title=A%20%E2%80%98missing%E2%80%99%20family%20of%20classical%20orthogonal%20polynomials&author=Luc.%20Vinet&author=Alexei.%20Zhedanov&journal=Journal%20of%20Physics%20A%3A%20Mathematical%20and%20Theoretical&volume=44&issue=8&pages=085201&publication_year=2011) (http://scholar.google.com/scholar\_lookup?title=A%20%E2%80%98missing%E2%80%99%20family%20of%20classical%20orthogonal%20polynomials&author=Luc.%20Vinet&author=Alexei.%20Zhedanov&journal=Journal%20of%20Physics%20A%3A%20Mathematical%20and%20Theoretical&volume=44&issue=8&pages=085201&publication\_year=2011)

Cuni-Sanchez A, Pfeifer M, Marchant R, Burgess ND (2016) Ethnic and locational differences in ecosystem service values: insights from the communities in forest islands in the desert. *Ecosyst Serv* 19:42–50

[CrossRef](https://doi.org/10.1016/j.ecoser.2016.04.004) (https://doi.org/10.1016/j.ecoser.2016.04.004)

[Google Scholar](http://scholar.google.com) (http://scholar.google.com

/scholar\_lookup?title=Ethnic%20and%20locational%20differences%20in%20ecosystem%20service%20values%3A%20insights%20from%20the%20communities%20in%20forest%20islands%20in%20the%20desert&author=A.%20Cuni-Sanchez&author=M.%20Pfeifer&author=R.%20Marchant&author=ND.%20Burgess&journal=Ecosyst%20Serv&volume=19&pages=42-50&publication\_year=2016)

Davies J, Robinson LW, Ericksen PJ (2015) Development process resilience and sustainable development: insights from the drylands of Eastern Africa. *Soc Nat Resour* 28(3):328–343

[CrossRef](https://doi.org/10.1080/08941920.2014.970734) (https://doi.org/10.1080/08941920.2014.970734)

[Google Scholar](http://scholar.google.com) (http://scholar.google.com

/scholar\_lookup?title=Development%20process%20resilience%20and%20sustainable%20development%3A%20insights%20from%20the%20drylands%20of%20Eastern%20Africa&author=J.%20Davies&author=LW.%20Robinson&author=PJ.%20Ericksen&

[journal=Soc%20Nat%20Resour&volume=28&issue=3&pages=328-343&publication\\_year=2015\)](#)

De Cort G, Verschuren D, Ryken E, Wolff C, Renaut RW, Creutz M, Van der Meeren T, Haug G, Olago DO, Mees F (2018) Multi-basin depositional framework for moisture-balance reconstruction during the last 1300 years at Lake Bogoria, central Kenya Rift Valley. *Sedimentology*

[Google Scholar](#) (<https://scholar.google.com/scholar?q=De%20Cort%20G%20Verschuren%20D%20Ryken%20E%20Wolff%20C%20Renaut%20RW%20Creutz%20M%20Van%20der%20Meeren%20T%20Haug%20G%20Olago%20DO%20Mees%20F%20%282018%29%20Multi-basin%20depositional%20framework%20for%20moisture-balance%20reconstruction%20during%20the%20last%201300%20years%20at%20Lake%20Bogoria%20central%20Kenya%20Rift%20Valley.%20Sedimentology>)

Dearing JA, Wang R, Zhang K, Dyke JG, Haberl H, Hossain MS, Langdon PG, Lenton TM, Raworth K, Brown S, Carstensen J (2014) Safe and just operating spaces for regional social-ecological systems. *Glob Environ Change* 28:227–238

[CrossRef](#) (<https://doi.org/10.1016/j.gloenvcha.2014.06.012>)  
[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Safe%20and%20just%20operating%20spaces%20for%20regional%20social-ecological%20systems&author=JA.%20Dearing&author=R.%20Wang&author=K.%20Zhang&author=JG.%20Dyke&author=H.%20Haberl&author=MS.%20Hossain&author=PG.%20Langdon&author=TM.%20Lenton&author=K.%20Raworth&author=S.%20Brown&author=J.%20Carstensen&journal=Glob%20Environ%20Change&volume=28&pages=227-238&publication\\_year=2014](http://scholar.google.com/scholar_lookup?title=Safe%20and%20just%20operating%20spaces%20for%20regional%20social-ecological%20systems&author=JA.%20Dearing&author=R.%20Wang&author=K.%20Zhang&author=JG.%20Dyke&author=H.%20Haberl&author=MS.%20Hossain&author=PG.%20Langdon&author=TM.%20Lenton&author=K.%20Raworth&author=S.%20Brown&author=J.%20Carstensen&journal=Glob%20Environ%20Change&volume=28&pages=227-238&publication_year=2014))

Ellis EC, Fuller DQ, Kaplan JO, Lutters WG (2013) Dating the anthropocene: towards an empirical global history of human transformation of the terrestrial biosphere. *Elem Sci Anthr* 1, 1–6

[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Dating%20the%20Anthropocene%3A%20Towards%20an%20empirical%20global%20history%20of%20human%20transformation%20of%20the%20terrestrial%20biosphere&author=Erle%20C.%20Ellis&author=Dorian%20Q.%20Fuller&author=Jed%20O.%20Kaplan&author=Wayne%20G.%20Lutters&journal=Elementa%3A%20Science%20of%20the%20Anthropocene&volume=1&pages=000018&publication\\_year=2013](http://scholar.google.com/scholar_lookup?title=Dating%20the%20Anthropocene%3A%20Towards%20an%20empirical%20global%20history%20of%20human%20transformation%20of%20the%20terrestrial%20biosphere&author=Erle%20C.%20Ellis&author=Dorian%20Q.%20Fuller&author=Jed%20O.%20Kaplan&author=Wayne%20G.%20Lutters&journal=Elementa%3A%20Science%20of%20the%20Anthropocene&volume=1&pages=000018&publication_year=2013))

Finch J, Leng MJ, Marchant R (2009) Late quaternary vegetation dynamics in a biodiversity hotspot, the Uluguru Mountains of Tanzania. *Quat Res* 72(1):111–122

[CrossRef](#) (<https://doi.org/10.1016/j.yqres.2009.02.005>)  
[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Late%20quaternary%20vegetation%20dynamics%20in%20a%20biodiversity%20hotspot%20of%20the%20Uluguru%20Mountains%20of%20Tanzania&author=J.%20Finch&author=MJ.%20Leng&author=R.%20Marchant&journal=Quat%20Res&volume=72&issue=1&pages=111-122&publication\\_year=2009](http://scholar.google.com/scholar_lookup?title=Late%20quaternary%20vegetation%20dynamics%20in%20a%20biodiversity%20hotspot%20of%20the%20Uluguru%20Mountains%20of%20Tanzania&author=J.%20Finch&author=MJ.%20Leng&author=R.%20Marchant&journal=Quat%20Res&volume=72&issue=1&pages=111-122&publication_year=2009))

Gasse F, Van Campo E (1994) Abrupt post-glacial climate events in West Asia and North Africa monsoon domains. *Earth Planet Sci Lett* 126(4):435–456

[CrossRef](#) ([https://doi.org/10.1016/0012-821X\(94\)90123-6](https://doi.org/10.1016/0012-821X(94)90123-6))  
[Google Scholar](#) (<http://scholar.google.com>)

[/scholar\\_lookup?title=Abrupt%20post-glacial%20climate%20events%20in%20West%20Asia%20and%20North%20Africa%20monsoon%20domains&author=F.%20Gasse&author=E.%20Campo&journal=Earth%20Planet%20Sci%20Lett&volume=126&issue=4&pages=435-456&publication\\_year=1994](#)

Gillson L (2004) Testing non-equilibrium theories in savannas: 1400 Years of vegetation change in Tsavo National Park, Kenya. *Ecol Complex* 1(4):281–298  
[CrossRef](#) (<https://doi.org/10.1016/j.ecocom.2004.06.001>)  
[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Testing%20non-equilibrium%20theories%20in%20savannas%3A%201400%20Years%20of%20vegetation%20change%20in%20Tsavo%20National%20Park%2C%20Kenya&author=L.%20Gillson&journal=Ecol%20Complex&volume=1&issue=4&pages=281-298&publication\\_year=2004](http://scholar.google.com/scholar_lookup?title=Testing%20non-equilibrium%20theories%20in%20savannas%3A%201400%20Years%20of%20vegetation%20change%20in%20Tsavo%20National%20Park%2C%20Kenya&author=L.%20Gillson&journal=Ecol%20Complex&volume=1&issue=4&pages=281-298&publication_year=2004))

Gillson L, Duffin KI (2007) Thresholds of potential concern as benchmarks in the management of African savannas. *Philos Trans R Soc B Biol Sci* 362(1478):309–319  
[CrossRef](#) (<https://doi.org/10.1098/rstb.2006.1988>)  
[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Thresholds%20of%20potential%20concern%20as%20benchmarks%20in%20the%20management%20of%20African%20savannas&author=L.%20Gillson&author=KI.%20Duffin&journal=Philos%20Trans%20R%20Soc%20B%20Biol%20Sci&volume=362&issue=1478&pages=309-319&publication\\_year=2007](http://scholar.google.com/scholar_lookup?title=Thresholds%20of%20potential%20concern%20as%20benchmarks%20in%20the%20management%20of%20African%20savannas&author=L.%20Gillson&author=KI.%20Duffin&journal=Philos%20Trans%20R%20Soc%20B%20Biol%20Sci&volume=362&issue=1478&pages=309-319&publication_year=2007))

Gillson L, Ekblom A (2009) Resilience and thresholds in Savannas: nitrogen and fire as drivers and responders of vegetation transition. *Ecosystems* 12(7):1189–1203  
[CrossRef](#) (<https://doi.org/10.1007/s10021-009-9284-y>)  
[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Resilience%20and%20thresholds%20in%20Savannas%3A%20nitrogen%20and%20fire%20as%20drivers%20and%20responders%20of%20vegetation%20transition&author=L.%20Gillson&author=A.%20Ekblom&journal=Ecosystems&volume=12&issue=7&pages=1189-1203&publication\\_year=2009](http://scholar.google.com/scholar_lookup?title=Resilience%20and%20thresholds%20in%20Savannas%3A%20nitrogen%20and%20fire%20as%20drivers%20and%20responders%20of%20vegetation%20transition&author=L.%20Gillson&author=A.%20Ekblom&journal=Ecosystems&volume=12&issue=7&pages=1189-1203&publication_year=2009))

Gillson L, Marchant R (2014) From myopia to clarity: Sharpening the focus of ecosystem management through the lens of palaeoecology. *Trends Ecol Evol* 29(6):317–325  
[CrossRef](#) (<https://doi.org/10.1016/j.tree.2014.03.010>)  
[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=From%20myopia%20to%20clarity%3A%20Sharpening%20the%20focus%20of%20ecosystem%20management%20through%20the%20lens%20of%20palaeoecology&author=L.%20Gillson&author=R.%20Marchant&journal=Trends%20Ecol%20Evol&volume=29&issue=6&pages=317-325&publication\\_year=2014](http://scholar.google.com/scholar_lookup?title=From%20myopia%20to%20clarity%3A%20Sharpening%20the%20focus%20of%20ecosystem%20management%20through%20the%20lens%20of%20palaeoecology&author=L.%20Gillson&author=R.%20Marchant&journal=Trends%20Ecol%20Evol&volume=29&issue=6&pages=317-325&publication_year=2014))

Githumbi EN (2017) Holocene environmental and human interactions in East Africa. PhD Dissertation, University of York  
[Google Scholar](#) (<https://scholar.google.com/scholar?q=Githumbi%20EN%20%282017%29%20Holocene%20environmental%20and%20human%20interactions%20in%20East%20Africa.%20PhD%20Dissertation%2C%20University%20of%20York>)  
 Githumbi EN, Mustaphi CJC, Yun KJ, Muiruri V, Rucina SM, Marchant R (2018)

Late Holocene wetland transgression and 500 years of vegetation and fire variability in the semi-arid Amboseli landscape, southern Kenya. *Ambio* 47(6):682–696

[CrossRef](https://doi.org/10.1007/s13280-018-1014-2) (https://doi.org/10.1007/s13280-018-1014-2)

[Google Scholar](http://scholar.google.com) (http://scholar.google.com)

/scholar\_lookup?title=Late%20Holocene%20wetland%20transgression%20and%20500%20years%20of%20vegetation%20and%20fire%20variability%20in%20the%20semi-arid%20Amboseli%20landscape%20southern%20Kenya&author=EN.%20Githumbi&author=CJC.%20Mustaphi&author=KJ.%20Yun&author=V.%20Muiruri&author=SM.%20Rucina&author=R.%20Marchant&journal=Ambio&volume=47&issue=6&pages=682-696&publication\_year=2018)

Griggs DJ, Noguer M (2002) Climate change 2001: the scientific basis.

Contribution of working group I to the third assessment report of the intergovernmental panel on climate change. *Weather*. <https://doi.org/10.1256/004316502320517344> (https://doi.org/10.1256/004316502320517344)

[CrossRef](https://doi.org/10.1256/004316502320517344) (https://doi.org/10.1256/004316502320517344)

[Google Scholar](http://scholar.google.com) (http://scholar.google.com)

/scholar\_lookup?title=Climate%20change%202001%3A%20The%20scientific%20basis.%20Contribution%20of%20Working%20Group%20I%20to%20the%20Third%20Assessment%20Report%20of%20the%20Intergovernmental%20Panel%20on%20Climate%20Change&author=David%20J.%20Griggs&author=Maria.%20Noguer&journal=Weather&volume=57&issue=8&pages=267-269&publication\_year=2002)

Heckmann M (2011) Soil erosion history and past human land use in the North Pare Mountains: a geoarchaeological study of slope deposits in northeastern Tanzania. University of York. <http://www.tandfonline.com/doi/abs/10.1080/0067270X.2012.707484>

<http://www.tandfonline.com/doi/abs/10.1080/0067270X.2012.707484>

<http://www.tandfonline.com/doi/abs/10.1080/0067270X.2012.707484>

<http://www.tandfonline.com/doi/abs/10.1080/0067270X.2012.707484>

<http://www.tandfonline.com/doi/abs/10.1080/0067270X.2012.707484>

<http://www.tandfonline.com/doi/abs/10.1080/0067270X.2012.707484>

Heckmann M (2014) Farmers, smelters and caravans: two thousand years of land use and soil erosion in North Pare, NE Tanzania. *Catena* 113:187–201

[CrossRef](https://doi.org/10.1016/j.catena.2013.07.010) (https://doi.org/10.1016/j.catena.2013.07.010)

[Google Scholar](http://scholar.google.com/scholar_lookup?title=Farmers) (http://scholar.google.com/scholar\_lookup?title=Farmers

%2C%20smelters%20and%20caravans

%3A%20two%20thousand%20years%20of%20land%20use%20and%20soil%20erosion%20in%20North%20Pare%20NE%20Tanzania&

author=M.%20Heckmann&journal=Catena&volume=113&pages=187-201&

publication\_year=2014)

Kan N, Djoghla A (2010) Planet our opportunity. *Our Planet*, (September), 1–36.

[www.unep.org/ourplanet](http://www.unep.org/ourplanet) (http://www.unep.org/ourplanet), Accessed 28 Nov 2018

Kiage LM, Liu K (2009) Paleoenvironmental changes in the Lake Baringo Basin, Kenya, East Africa Since AD 1650: evidence from the paleorecord. *Prof Geogr* 61(4):438–458

[CrossRef](https://doi.org/10.1080/00330120903143425) (https://doi.org/10.1080/00330120903143425)

[Google Scholar](http://scholar.google.com) (http://scholar.google.com)

/scholar\_lookup?title=Paleoenvironmental%20changes%20in%20the%20Lake%20Baringo%20Basin%20Kenya%20East%20Africa%20Since%20AD%201650%3A%20evidence%20from%20the%20paleorecord&author=LM.%20Kiage&

[author=K.%20Liu&journal=Prof%20Geogr&volume=61&issue=4&pages=438-458&publication\\_year=2009\)](#)

King'uyu SM, Ogallo LA, Anyamba EK (2000) Recent trends of minimum and maximum surface temperatures over Eastern Africa. *J Clim* 13(16), 2876–2886

[CrossRef](#) ([https://doi.org/10.1175/1520-0442\(2000\)013<2876%3ARTOMAM>2.0.CO%3B2](https://doi.org/10.1175/1520-0442(2000)013<2876%3ARTOMAM>2.0.CO%3B2))

[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Recent%20Trends%20of%20Minimum%20and%20Maximum%20Surface%20Temperatures%20over%20Eastern%20Africa&author=S.%20M..%20King%E2%80%99uyu&author=L.%20A..%20Ogallo&author=E.%20K..%20Anyamba&journal=Journal%20of%20Climate&volume=13&issue=16&pages=2876-2886&publication\\_year=2000](http://scholar.google.com/scholar_lookup?title=Recent%20Trends%20of%20Minimum%20and%20Maximum%20Surface%20Temperatures%20over%20Eastern%20Africa&author=S.%20M..%20King%E2%80%99uyu&author=L.%20A..%20Ogallo&author=E.%20K..%20Anyamba&journal=Journal%20of%20Climate&volume=13&issue=16&pages=2876-2886&publication_year=2000))

Lin L, Sills E, Cheshire H (2014) Targeting areas for reducing emissions from deforestation and forest degradation (REDD+) projects in Tanzania. *Glob Environ Change* 24:277–286

[CrossRef](#) (<https://doi.org/10.1016/j.gloenvcha.2013.12.003>)

[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Targeting%20areas%20for%20reducing%20emissions%20from%20deforestation%20and%20forest%20degradation%20%28REDD%2B%29%20projects%20in%20Tanzania&author=L.%20Lin&author=E.%20Sills&author=H.%20Cheshire&journal=Glob%20Environ%20Change&volume=24&pages=277-286&publication\\_year=2014](http://scholar.google.com/scholar_lookup?title=Targeting%20areas%20for%20reducing%20emissions%20from%20deforestation%20and%20forest%20degradation%20%28REDD%2B%29%20projects%20in%20Tanzania&author=L.%20Lin&author=E.%20Sills&author=H.%20Cheshire&journal=Glob%20Environ%20Change&volume=24&pages=277-286&publication_year=2014))

Lindenschmidt KE, Suhr M, Magumba MK, Hecky RE, Bugenyi FWB (1998) Loading of solute and suspended solids from rural catchment areas flowing into Lake Victoria in Uganda. *Water Res* 32(9):2776–2786

[CrossRef](#) ([https://doi.org/10.1016/S0043-1354\(98\)00027-X](https://doi.org/10.1016/S0043-1354(98)00027-X))

[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Loading%20of%20solute%20and%20suspended%20solids%20from%20rural%20catchment%20areas%20flowing%20into%20Lake%20Victoria%20in%20Uganda&author=KE.%20Lindenschmidt&author=M.%20Suhr&author=MK.%20Magumba&author=RE.%20Hecky&author=FWB.%20Bugenyi&journal=Water%20Res&volume=32&issue=9&pages=2776-2786&publication\\_year=1998](http://scholar.google.com/scholar_lookup?title=Loading%20of%20solute%20and%20suspended%20solids%20from%20rural%20catchment%20areas%20flowing%20into%20Lake%20Victoria%20in%20Uganda&author=KE.%20Lindenschmidt&author=M.%20Suhr&author=MK.%20Magumba&author=RE.%20Hecky&author=FWB.%20Bugenyi&journal=Water%20Res&volume=32&issue=9&pages=2776-2786&publication_year=1998))

Loomis SE, Russell JM, Verschuren D, Morrill C, De Cort G, Damsté JSS, Olago D, Eggermont H, Street-Perrott FA, Kelly MA (2017) The tropical lapse rate steepened during the Last Glacial Maximum. *Sci Adv* 3(1):e1600815

[CrossRef](#) (<https://doi.org/10.1126/sciadv.1600815>)

[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=The%20tropical%20lapse%20rate%20steepened%20during%20the%20Last%20Glacial%20Maximum&author=SE.%20Loomis&author=JM.%20Russell&author=D.%20Verschuren&author=C.%20Morrill&author=G.%20Cort&author=JSS.%20Damst%C3%A9&author=D.%20Olago&author=H.%20Eggermont&author=FA.%20Street-Perrott&author=MA.%20Kelly&journal=Sci%20Adv&volume=3&issue=1&pages=e1600815&publication\\_year=2017](http://scholar.google.com/scholar_lookup?title=The%20tropical%20lapse%20rate%20steepened%20during%20the%20Last%20Glacial%20Maximum&author=SE.%20Loomis&author=JM.%20Russell&author=D.%20Verschuren&author=C.%20Morrill&author=G.%20Cort&author=JSS.%20Damst%C3%A9&author=D.%20Olago&author=H.%20Eggermont&author=FA.%20Street-Perrott&author=MA.%20Kelly&journal=Sci%20Adv&volume=3&issue=1&pages=e1600815&publication_year=2017))

Marchant R, Lane PJ (2014) Past perspectives for the future: foundations for sustainable development in East Africa. *J Archaeol Sci* 51:12–21

[CrossRef](#) (<https://doi.org/10.1016/j.jas.2013.07.005>)

[Google Scholar](#) ([http://scholar.google.com/scholar\\_lookup?title=Past%20perspectives%20for%20the%20future%20%3A%20foundations%20for%20sustainable%20development%20in%20East%20Africa&author=R.%20Marchant&author=PJ.%20Lane&](http://scholar.google.com/scholar_lookup?title=Past%20perspectives%20for%20the%20future%20%3A%20foundations%20for%20sustainable%20development%20in%20East%20Africa&author=R.%20Marchant&author=PJ.%20Lane&)

[journal=J%20Archaeol%20Sci&volume=51&pages=12-21&publication\\_year=2014\)](#)

Marchant R, Finch J, Kinyanjui R, Muiruri V, Mumbi C, Platts PJ, Rucina S (2010) Palaeoenvironmental perspectives for sustainable development in East Africa. *Clim Past Discuss* 3:963–1007

[CrossRef](#) (<https://doi.org/10.5194/cpd-6-963-2010>)

[Google Scholar](#) (<http://scholar.google.com>

[/scholar\\_lookup?title=Palaeoenvironmental%20perspectives%20for%20sustainable%20development%20in%20East%20Africa&author=R.%20Marchant&author=J.%20Finch&author=R.%20Kinyanjui&author=V.%20Muiruri&author=C.%20Mumbi&author=PJ.%20Platts&author=S.%20Rucina&journal=Clim%20Past%20Discuss&volume=3&pages=963-1007&publication\\_year=2010\)](#)

Marchant R, Richer S, Capitani C, Courtney-Mustaphi C, Prendergast M, Stump D, Boles O, Lane P, Wynne-Jones S, Vázquez CF, Wright D (2018) Drivers and trajectories of land cover change in East Africa: human and environmental interactions from 6000 years ago to present. *Earth-Sci Rev* 178. <https://doi.org/10.1016/j.earscirev.2017.12.010> (<https://doi.org/10.1016/j.earscirev.2017.12.010>)

[CrossRef](#) (<https://doi.org/10.1016/j.earscirev.2017.12.010>)

[Google Scholar](#) (<http://scholar.google.com>

[/scholar\\_lookup?title=Drivers%20and%20trajectories%20of%20land%20cover%20change%20in%20East%20Africa%3A%20Human%20and%20environmental%20interactions%20from%206000%20years%20ago%20to%20present&author=Rob.%20Marchant&author=Suzi.%20Richer&author=Oliver.%20Boles&author=Claudia.%20Capitani&author=Colin%20J..%20Courtney-Mustaphi&author=Paul.%20Lane&author=Mary%20E..%20Prendergast&author=Daryl.%20Stump&author=Gijs.%20De%20Cort&author=Jed%20O..%20Kaplan&author=Leanne.%20Phelps&author=Andrea.%20Kay&author=Dan.%20Olago&author=Nik.%20Petek&author=Philip%20J..%20Platts&author=Paramita.%20Punwong&author=Mats.%20Widgren&author=Stephanie.%20Wynne-Jones&author=Cruz.%20Ferro-V%3A%20Izquez&author=Jacquiline.%20Benard&author=Nicole.%20Boivin&author=Alison.%20Crowther&author=Aida.%20Cun%3AD-Sanchez&author=Nicolas%20J..%20Deere&author=Anneli.%20Ekblom&author=Jennifer.%20Farmer&author=Jemma.%20Finch&author=Dorian.%20Fuller&author=Marie-Jos%3A%20Gaillard-Lemdahl&author=Lindsey.%20Gillson&author=Esther.%20Githumbi&author=Tabitha.%20Kabora&author=Rebecca.%20Kariuki&author=Rahab.%20Kinyanjui&author=Elizabeth.%20Kyazike&author=Carol.%20Lang&author=Julius.%20Lejju&author=Kathleen%20D..%20Morrison&author=Veronica.%20Muiruri&author=Cassian.%20Mumbi&author=Rebecca.%20Muthoni&author=Alfred.%20Muzuka&author=Emmanuel.%20Ndiema&author=Chantal.%20Kabonyi%20Nzabandora&author=Isaya.%20Onjala&author=Annemiek%20Pas.%20Schrijver&author=Stephen.%20Rucina&author=Anna.%20Shoemaker&author=Senna.%20Thornton-Barnett&author=Geert.%20van%20der%20Plas&author=Elizabeth%20E..%20Watson&author=David.%20Williamson&author=David.%20Wright&journal=Earth-Science%20Reviews&volume=178&pages=322-378&publication\\_year=2018\)](#)



- McGlynn G, Mooney S, Taylor DM (2013) Palaeoecological evidence for Holocene environmental change from the Virunga volcanoes in the Albertine Rift, central Africa. *Quat Sci Rev* 61:32–46  
[CrossRef](https://doi.org/10.1016/j.quascirev.2012.11.008) (<https://doi.org/10.1016/j.quascirev.2012.11.008>)  
[Google Scholar](http://scholar.google.com) (<http://scholar.google.com>)  
[/scholar\\_lookup?title=Palaeoecological%20evidence%20for%20Holocene%20environmental%20change%20from%20the%20Virunga%20volcanoes%20in%20the%20Albertine%20Rift%20C%20central%20Africa&author=G.%20McGlynn&author=S.%20Mooney&author=DM.%20Taylor&journal=Quat%20Sci%20Rev&volume=61&pages=32-46&publication\\_year=2013](http://scholar_lookup?title=Palaeoecological%20evidence%20for%20Holocene%20environmental%20change%20from%20the%20Virunga%20volcanoes%20in%20the%20Albertine%20Rift%20C%20central%20Africa&author=G.%20McGlynn&author=S.%20Mooney&author=DM.%20Taylor&journal=Quat%20Sci%20Rev&volume=61&pages=32-46&publication_year=2013))
- McKee BA, Cohen AS, Dettman DL, Palacios-Fest MR, Alin SR, Ntungumburanye G (2005) Paleolimnological investigations of anthropogenic environmental change in Lake Tanganyika: II. geochronologies and mass sedimentation rates based on 14 C and 210 Pb data. *J Paleolimnol* 34(1):19–29  
[CrossRef](https://doi.org/10.1007/s10933-005-2395-3) (<https://doi.org/10.1007/s10933-005-2395-3>)  
[Google Scholar](http://scholar.google.com) (<http://scholar.google.com>)  
[/scholar\\_lookup?title=Paleolimnological%20investigations%20of%20anthropogenic%20environmental%20change%20in%20Lake%20Tanganyika%3A%20II.%20geochronologies%20and%20mass%20sedimentation%20rates%20based%20on%2014%20C%20and%20210%20Pb%20data&author=BA.%20McKee&author=AS.%20Cohen&author=DL.%20Dettman&author=MR.%20Palacios-Fest&author=SR.%20Alin&author=G.%20Ntungumburanye&journal=J%20Paleolimnol&volume=34&issue=1&pages=19-29&publication\\_year=2005](http://scholar_lookup?title=Paleolimnological%20investigations%20of%20anthropogenic%20environmental%20change%20in%20Lake%20Tanganyika%3A%20II.%20geochronologies%20and%20mass%20sedimentation%20rates%20based%20on%2014%20C%20and%20210%20Pb%20data&author=BA.%20McKee&author=AS.%20Cohen&author=DL.%20Dettman&author=MR.%20Palacios-Fest&author=SR.%20Alin&author=G.%20Ntungumburanye&journal=J%20Paleolimnol&volume=34&issue=1&pages=19-29&publication_year=2005))
- Mumbi CT, Marchant R, Hooghiemstra H, Wooller MJ (2008) Late Quaternary vegetation reconstruction from the eastern Arc mountains, Tanzania. *Quat Res* 69(2):326–341  
[CrossRef](https://doi.org/10.1016/j.yqres.2007.10.012) (<https://doi.org/10.1016/j.yqres.2007.10.012>)  
[Google Scholar](http://scholar.google.com) (<http://scholar.google.com>)  
[/scholar\\_lookup?title=Late%20Quaternary%20vegetation%20reconstruction%20from%20the%20eastern%20Arc%20mountains%20C%20Tanzania&author=CT.%20Mumbi&author=R.%20Marchant&author=H.%20Hooghiemstra&author=MJ.%20Wooller&journal=Quat%20Res&volume=69&issue=2&pages=326-341&publication\\_year=2008](http://scholar_lookup?title=Late%20Quaternary%20vegetation%20reconstruction%20from%20the%20eastern%20Arc%20mountains%20C%20Tanzania&author=CT.%20Mumbi&author=R.%20Marchant&author=H.%20Hooghiemstra&author=MJ.%20Wooller&journal=Quat%20Res&volume=69&issue=2&pages=326-341&publication_year=2008))
- Muwanga A, Barifaijo E (2006) Impact of industrial activities on heavy metal loading and their physico-chemical effects on wetlands of Lake Victoria basin (Uganda). *Afr J Sci Technol* 7(1):51–63  
[Google Scholar](http://scholar.google.com) (<http://scholar.google.com>)  
[/scholar\\_lookup?title=Impact%20of%20industrial%20activities%20on%20heavy%20metal%20loading%20and%20their%20physico-chemical%20effects%20on%20wetlands%20of%20Lake%20Victoria%20basin%20%28Uganda%29&author=A.%20Muwanga&author=E.%20Barifaijo&journal=Afr%20J%20Sci%20Technol&volume=7&issue=1&pages=51-63&publication\\_year=2006](http://scholar_lookup?title=Impact%20of%20industrial%20activities%20on%20heavy%20metal%20loading%20and%20their%20physico-chemical%20effects%20on%20wetlands%20of%20Lake%20Victoria%20basin%20%28Uganda%29&author=A.%20Muwanga&author=E.%20Barifaijo&journal=Afr%20J%20Sci%20Technol&volume=7&issue=1&pages=51-63&publication_year=2006))
- Nair KR, Manji F, Gitonga JN (1984) The occurrence and distribution of fluoride in groundwaters of Kenya. *East Afr Med J* 61(7):503–512  
[Google Scholar](http://scholar.google.com) (<http://scholar.google.com>)  
[/scholar\\_lookup?title=The%20occurrence%20and%20distribution%20of%20fluoride%20in%20groundwaters%20of%20Kenya&author=KR.%20Nair&author=F.%20Manji&author=JN.%20Gitonga&journal=East%20Afr%20Med%20J&volume=61&issue=7&pages=503-512&publication\\_year=1984](http://scholar_lookup?title=The%20occurrence%20and%20distribution%20of%20fluoride%20in%20groundwaters%20of%20Kenya&author=KR.%20Nair&author=F.%20Manji&author=JN.%20Gitonga&journal=East%20Afr%20Med%20J&volume=61&issue=7&pages=503-512&publication_year=1984))

Odada E, Olago D (2005) Holocene climatic, hydrological and environmental oscillations in the tropics with special reference to Africa. *Clim Change Afr* pp 3–22

[Google Scholar](https://scholar.google.com/scholar?q=Odada%20E%2C%20Olago%20D%20%282005%29%20Holocene%20climatic%2C%20hydrological%20and%20environmental%20oscillations%20in%20the%20tropics%20with%20special%20reference%20to%20Africa.%20Clim%20Change%20Afr%20pp%203%E2%80%9322) (<https://scholar.google.com/scholar?q=Odada%20E%2C%20Olago%20D%20%282005%29%20Holocene%20climatic%2C%20hydrological%20and%20environmental%20oscillations%20in%20the%20tropics%20with%20special%20reference%20to%20Africa.%20Clim%20Change%20Afr%20pp%203%E2%80%9322>)

Odada EO, Olago DO, Kulindwa K, Ntiba M, Wandiga S (2004) Mitigation of environmental problems in Lake Victoria, East Africa: causal chain and policy options analyses. *Ambio* 33(1):13–24

[CrossRef](https://doi.org/10.1579/0044-7447-33.1.13) (<https://doi.org/10.1579/0044-7447-33.1.13>)

[Google Scholar](http://scholar.google.com/scholar_lookup?title=Mitigation%20of%20environmental%20problems%20in%20Lake%20Victoria%2C%20East%20Africa%20%3A%20causal%20chain%20and%20policy%20options%20analyses&author=EO.%20Odada&author=DO.%20Olago&author=K.%20Kulindwa&author=M.%20Ntiba&author=S.%20Wandiga&journal=Ambio&volume=33&issue=1&pages=13-24&publication_year=2004) ([http://scholar.google.com/scholar\\_lookup?title=Mitigation%20of%20environmental%20problems%20in%20Lake%20Victoria%2C%20East%20Africa%20%3A%20causal%20chain%20and%20policy%20options%20analyses&author=EO.%20Odada&author=DO.%20Olago&author=K.%20Kulindwa&author=M.%20Ntiba&author=S.%20Wandiga&journal=Ambio&volume=33&issue=1&pages=13-24&publication\\_year=2004](http://scholar.google.com/scholar_lookup?title=Mitigation%20of%20environmental%20problems%20in%20Lake%20Victoria%2C%20East%20Africa%20%3A%20causal%20chain%20and%20policy%20options%20analyses&author=EO.%20Odada&author=DO.%20Olago&author=K.%20Kulindwa&author=M.%20Ntiba&author=S.%20Wandiga&journal=Ambio&volume=33&issue=1&pages=13-24&publication_year=2004))

Olago DO, Umer M, Ringrose S, Huntsman-Mapila P, Sow EH, Damnati B (2007) Palaeoclimate of Africa: an overview since the last glacial maximum. *Global change processes and impacts in Africa: a synthesis*. East African Educational Publishers, Nairobi, pp 1–32

[Google Scholar](https://scholar.google.com/scholar?q=Olago%20DO%2C%20Umer%20M%2C%20Ringrose%20S%2C%20Huntsman-Mapila%20P%2C%20Sow%20EH%2C%20Damnati%20B%20%282007%29%20Palaeoclimate%20of%20Africa%20%3A%20an%20overview%20since%20the%20last%20glacial%20maximum.%20Global%20change%20processes%20and%20impacts%20in%20Africa%20%3A%20a%20synthesis.%20East%20African%20Educational%20Publishers%20%2C%20Nairobi%2C%20pp%201%E2%80%9332) (<https://scholar.google.com/scholar?q=Olago%20DO%2C%20Umer%20M%2C%20Ringrose%20S%2C%20Huntsman-Mapila%20P%2C%20Sow%20EH%2C%20Damnati%20B%20%282007%29%20Palaeoclimate%20of%20Africa%20%3A%20an%20overview%20since%20the%20last%20glacial%20maximum.%20Global%20change%20processes%20and%20impacts%20in%20Africa%20%3A%20a%20synthesis.%20East%20African%20Educational%20Publishers%20%2C%20Nairobi%2C%20pp%201%E2%80%9332>)

Olago D, Opere A, Barongo J (2009) Holocene palaeohydrology, groundwater and climate change in the lake basins of the Central Kenya Rift. *Hydrol Sci J* 54(4):765–780

[CrossRef](https://doi.org/10.1623/hysj.54.4.765) (<https://doi.org/10.1623/hysj.54.4.765>)

[Google Scholar](http://scholar.google.com/scholar_lookup?title=Holocene%20palaeohydrology%2C%20groundwater%20and%20climate%20change%20in%20the%20lake%20basins%20of%20the%20Central%20Kenya%20Rift&author=D.%20Olago&author=A.%20Opere&author=J.%20Barongo&journal=Hydrol%20Sci%20J&volume=54&issue=4&pages=765-780&publication_year=2009) ([http://scholar.google.com/scholar\\_lookup?title=Holocene%20palaeohydrology%2C%20groundwater%20and%20climate%20change%20in%20the%20lake%20basins%20of%20the%20Central%20Kenya%20Rift&author=D.%20Olago&author=A.%20Opere&author=J.%20Barongo&journal=Hydrol%20Sci%20J&volume=54&issue=4&pages=765-780&publication\\_year=2009](http://scholar.google.com/scholar_lookup?title=Holocene%20palaeohydrology%2C%20groundwater%20and%20climate%20change%20in%20the%20lake%20basins%20of%20the%20Central%20Kenya%20Rift&author=D.%20Olago&author=A.%20Opere&author=J.%20Barongo&journal=Hydrol%20Sci%20J&volume=54&issue=4&pages=765-780&publication_year=2009))

Olaka LA, Odada EO, Trauth MH, Olago DO (2010) The sensitivity of East African rift lakes to climate fluctuations. *J Paleolimnol* 44(2):629–644 <https://doi.org/10.1007/s10933-010-9442-4> (<https://doi.org/10.1007/s10933-010-9442-4>)

[CrossRef](https://doi.org/10.1007/s10933-010-9442-4) (<https://doi.org/10.1007/s10933-010-9442-4>)

[Google Scholar](http://scholar.google.com/scholar_lookup?title=The%20sensitivity%20of%20East%20African%20rift%20lakes%20to%20climate%20fluctuations&author=LA.%20Olaka&author=EO.%20Odada&author=MH.%20Trauth&author=DO.%20Olago&journal=J%20Paleolimnol&volume=44&issue=2&pages=629-644&publication_year=2010) ([http://scholar.google.com/scholar\\_lookup?title=The%20sensitivity%20of%20East%20African%20rift%20lakes%20to%20climate%20fluctuations&author=LA.%20Olaka&author=EO.%20Odada&author=MH.%20Trauth&author=DO.%20Olago&journal=J%20Paleolimnol&volume=44&issue=2&pages=629-644&publication\\_year=2010](http://scholar.google.com/scholar_lookup?title=The%20sensitivity%20of%20East%20African%20rift%20lakes%20to%20climate%20fluctuations&author=LA.%20Olaka&author=EO.%20Odada&author=MH.%20Trauth&author=DO.%20Olago&journal=J%20Paleolimnol&volume=44&issue=2&pages=629-644&publication_year=2010))

Oldfield F, Alverson K (2003) The societal relevance of paleoenvironmental

research. In: Alverson KD, Bradley RS, Pedersen TF (eds) Paleoclimate, global change and the future. Springer, Berlin, pp 1–11

[Google Scholar](http://scholar.google.com/scholar_lookup?title=The%20societal%20relevance%20of%20paleoenvironmental%20research&author=F.%20Oldfield&author=K.%20Alverson&pages=1-11&publication_year=2003) ([http://scholar.google.com/scholar\\_lookup?title=The%20societal%20relevance%20of%20paleoenvironmental%20research&author=F.%20Oldfield&author=K.%20Alverson&pages=1-11&publication\\_year=2003](http://scholar.google.com/scholar_lookup?title=The%20societal%20relevance%20of%20paleoenvironmental%20research&author=F.%20Oldfield&author=K.%20Alverson&pages=1-11&publication_year=2003))

Onywere S, Shisanya C, Obando J, Ndubi A, Masiga D, Irura Z, Mariita N, Maragia H (2013) Geospatial extent of 2011–2013 flooding from the Eastern African Rift Valley Lakes in Kenya and its implication on the ecosystems. In: Papers, Kenya Soda Lakes workshop. Kenya Wildlife Service Training Institute, Naivasha

[Google Scholar](https://scholar.google.com/scholar?q=Onywere%20S%20Shisanya%20C%20Obando%20J%20Ndubi%20A%20Masiga%20D%20Irura%20Z%20Mariita%20N%20Maragia%20H%20%282013%29%20Geospatial%20extent%20of%202011%E2%80%932013%20flooding%20from%20the%20Eastern%20African%20Rift%20Valley%20Lakes%20in%20Kenya%20and%20its%20implication%20on%20the%20ecosystems.%20In%3A%20Papers%20Kenya%20Soda%20Lakes%20workshop.%20Kenya%20Wildlife%20Service%20Training%20Institute%20Naivasha) (<https://scholar.google.com/scholar?q=Onywere%20S%20Shisanya%20C%20Obando%20J%20Ndubi%20A%20Masiga%20D%20Irura%20Z%20Mariita%20N%20Maragia%20H%20%282013%29%20Geospatial%20extent%20of%202011%E2%80%932013%20flooding%20from%20the%20Eastern%20African%20Rift%20Valley%20Lakes%20in%20Kenya%20and%20its%20implication%20on%20the%20ecosystems.%20In%3A%20Papers%20Kenya%20Soda%20Lakes%20workshop.%20Kenya%20Wildlife%20Service%20Training%20Institute%20Naivasha>)

Pelikka PK, Clark BJ, Gosa AG, Himberg N, Hurskainen P, Maeda E, Mwang'ombe J, Omoro LM, Siljander M (2013) Agricultural expansion and its consequences in the Taita Hills, Kenya. In: Developments in Earth surface processes, vol 16, pp 165–179

[Google Scholar](http://scholar.google.com/scholar_lookup?title=Agricultural%20Expansion%20and%20Its%20Consequences%20in%20the%20Taita%20Hills%20Kenya&author=Petri%20K.E.%20Pelikka&author=Barnaby%20J.F.%20Clark&author=Alemu%20Gonsamo.%20Gosa&author=Nina.%20Himberg&author=Pekka.%20Hurskainen&author=Eduardo.%20Maeda&author=James.%20Mwang%E2%80%99ombe&author=Loice%20M.A.%20Omoro&author=Mika.%20Siljander&pages=165-179&publication_year=2013) ([http://scholar.google.com/scholar\\_lookup?title=Agricultural%20Expansion%20and%20Its%20Consequences%20in%20the%20Taita%20Hills%20Kenya&author=Petri%20K.E.%20Pelikka&author=Barnaby%20J.F.%20Clark&author=Alemu%20Gonsamo.%20Gosa&author=Nina.%20Himberg&author=Pekka.%20Hurskainen&author=Eduardo.%20Maeda&author=James.%20Mwang%E2%80%99ombe&author=Loice%20M.A.%20Omoro&author=Mika.%20Siljander&pages=165-179&publication\\_year=2013](http://scholar.google.com/scholar_lookup?title=Agricultural%20Expansion%20and%20Its%20Consequences%20in%20the%20Taita%20Hills%20Kenya&author=Petri%20K.E.%20Pelikka&author=Barnaby%20J.F.%20Clark&author=Alemu%20Gonsamo.%20Gosa&author=Nina.%20Himberg&author=Pekka.%20Hurskainen&author=Eduardo.%20Maeda&author=James.%20Mwang%E2%80%99ombe&author=Loice%20M.A.%20Omoro&author=Mika.%20Siljander&pages=165-179&publication_year=2013))

Pfeifer M, Burgess ND, Swetnam RD et al (2012) Protected areas: mixed success in conserving East Africa's evergreen forests. PLoS ONE 7: e39337

[CrossRef](https://doi.org/10.1371/journal.pone.0039337) (<https://doi.org/10.1371/journal.pone.0039337>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?title=Protected%20Areas%20Mixed%20Success%20in%20Conserving%20East%20Africa%E2%80%99s%20Evergreen%20Forests&author=Marion.%20Pfeifer&author=Neil%20D.%20Burgess&author=Ruth%20D.%20Swetnam&author=Philip%20J.%20Platts&author=Simon.%20Willcock&author=Robert.%20Marchant&journal=PLoS%20ONE&volume=7&issue=6&pages=e39337&publication_year=2012) ([http://scholar.google.com/scholar\\_lookup?title=Protected%20Areas%20Mixed%20Success%20in%20Conserving%20East%20Africa%E2%80%99s%20Evergreen%20Forests&author=Marion.%20Pfeifer&author=Neil%20D.%20Burgess&author=Ruth%20D.%20Swetnam&author=Philip%20J.%20Platts&author=Simon.%20Willcock&author=Robert.%20Marchant&journal=PLoS%20ONE&volume=7&issue=6&pages=e39337&publication\\_year=2012](http://scholar.google.com/scholar_lookup?title=Protected%20Areas%20Mixed%20Success%20in%20Conserving%20East%20Africa%E2%80%99s%20Evergreen%20Forests&author=Marion.%20Pfeifer&author=Neil%20D.%20Burgess&author=Ruth%20D.%20Swetnam&author=Philip%20J.%20Platts&author=Simon.%20Willcock&author=Robert.%20Marchant&journal=PLoS%20ONE&volume=7&issue=6&pages=e39337&publication_year=2012))

Rockström J, Steffen W, Noone K, Persson Å, Chapin FS III, Lambin EF, Lenton TM, Scheffer M, Folke C, Schellnhuber HJ, Nykvist B (2009) A safe operating space for humanity. Nature 461:472–475

[CrossRef](https://doi.org/10.1038/461472a) (<https://doi.org/10.1038/461472a>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?title=A%20safe%20operating%20space%20for%20humanity&author=J.%20Rockstr%C3%B6m&author=W.%20Steffen&author=K.%20Noone&author=%C3%85.%20Persson&author=FS.%20Chapin&author=EF.%20Lambin&) ([http://scholar.google.com/scholar\\_lookup?title=A%20safe%20operating%20space%20for%20humanity&author=J.%20Rockstr%C3%B6m&author=W.%20Steffen&author=K.%20Noone&author=%C3%85.%20Persson&author=FS.%20Chapin&author=EF.%20Lambin&](http://scholar.google.com/scholar_lookup?title=A%20safe%20operating%20space%20for%20humanity&author=J.%20Rockstr%C3%B6m&author=W.%20Steffen&author=K.%20Noone&author=%C3%85.%20Persson&author=FS.%20Chapin&author=EF.%20Lambin&))

[author=TM.%20Lenton&author=M.%20Scheffer&author=C.%20Folke&author=HJ.%20Schellnhuber&author=B.%20Nykvist&journal=Nature&volume=461&pages=472-475&publication\\_year=2009](https://doi.org/10.1016/j.palaeo.2009.08.008)

Rucina SM, Muiruri VM, Kinyanjui RN, McGuinness K, Marchant R (2009) Late Quaternary vegetation and fire dynamics on mount Kenya. *Palaeogeogr Palaeoclimatol Palaeoecol* 283(1–2):1–14

[CrossRef](https://doi.org/10.1016/j.palaeo.2009.08.008) (<https://doi.org/10.1016/j.palaeo.2009.08.008>)

[Google Scholar](http://scholar.google.com) (<http://scholar.google.com>)

[/scholar\\_lookup?title=Late%20Quaternary%20vegetation%20and%20fire%20dynamics%20on%20mount%20Kenya&author=SM.%20Rucina&author=VM.%20Muiruri&author=RN.%20Kinyanjui&author=K.%20McGuinness&author=R.%20Marchant&journal=Palaeogeogr%20Palaeoclimatol%20Palaeoecol&volume=283&issue=1&pages=1-14&publication\\_year=2009](http://scholar.google.com/scholar_lookup?title=Late%20Quaternary%20vegetation%20and%20fire%20dynamics%20on%20mount%20Kenya&author=SM.%20Rucina&author=VM.%20Muiruri&author=RN.%20Kinyanjui&author=K.%20McGuinness&author=R.%20Marchant&journal=Palaeogeogr%20Palaeoclimatol%20Palaeoecol&volume=283&issue=1&pages=1-14&publication_year=2009)

Rucina SM, Muiruri VM, Downton L, Marchant R (2010) Late-Holocene savanna dynamics in the Amboseli Basin, Kenya. *Holocene* 20(5):667–677

[CrossRef](https://doi.org/10.1177/0959683609358910) (<https://doi.org/10.1177/0959683609358910>)

[Google Scholar](http://scholar.google.com/scholar_lookup?title=Late-Holocene%20savanna%20dynamics%20in%20the%20Amboseli%20Basin%20C%20Kenya&author=SM.%20Rucina&author=VM.%20Muiruri&author=L.%20Downton&author=R.%20Marchant&journal=Holocene&volume=20&issue=5&pages=667-677&publication_year=2010) ([http://scholar.google.com/scholar\\_lookup?title=Late-Holocene%20savanna%20dynamics%20in%20the%20Amboseli%20Basin%20C%20Kenya&author=SM.%20Rucina&author=VM.%20Muiruri&author=L.%20Downton&author=R.%20Marchant&journal=Holocene&volume=20&issue=5&pages=667-677&publication\\_year=2010](http://scholar.google.com/scholar_lookup?title=Late-Holocene%20savanna%20dynamics%20in%20the%20Amboseli%20Basin%20C%20Kenya&author=SM.%20Rucina&author=VM.%20Muiruri&author=L.%20Downton&author=R.%20Marchant&journal=Holocene&volume=20&issue=5&pages=667-677&publication_year=2010))

Rull V (2014) Time continuum and true long-term ecology: from theory to practice. *Front Ecol Evol* 2:1–7

[CrossRef](https://doi.org/10.3389/fevo.2014.00075) (<https://doi.org/10.3389/fevo.2014.00075>)

[Google Scholar](http://scholar.google.com) (<http://scholar.google.com>)

[/scholar\\_lookup?title=Time%20continuum%20and%20true%20long-term%20ecology%3A%20from%20theory%20to%20practice&author=V.%20Rull&journal=Front%20Ecol%20Evol&volume=2&pages=1-7&publication\\_year=2014](http://scholar.google.com/scholar_lookup?title=Time%20continuum%20and%20true%20long-term%20ecology%3A%20from%20theory%20to%20practice&author=V.%20Rull&journal=Front%20Ecol%20Evol&volume=2&pages=1-7&publication_year=2014)

Seki HA, Shirima DD, Courtney Mustaphi CJ, Marchant R, Munishi PK (2018) The impact of land use and land cover change on biodiversity within and adjacent to Kibasira Swamp in Kilombero Valley, Tanzania. *Afr J Ecol* 56(3):518–527

[CrossRef](https://doi.org/10.1111/aje.12488) (<https://doi.org/10.1111/aje.12488>)

[Google Scholar](http://scholar.google.com) (<http://scholar.google.com>)

[/scholar\\_lookup?title=The%20impact%20of%20land%20use%20and%20land%20cover%20change%20on%20biodiversity%20within%20and%20adjacent%20to%20Kibasira%20Swamp%20in%20Kilombero%20Valley%20C%20Tanzania&author=HA.%20Seki&author=DD.%20Shirima&author=CJ.%20Courtney%20Mustaphi&author=R.%20Marchant&author=PK.%20Munishi&journal=Afr%20J%20Ecol&volume=56&issue=3&pages=518-527&publication\\_year=2018](http://scholar.google.com/scholar_lookup?title=The%20impact%20of%20land%20use%20and%20land%20cover%20change%20on%20biodiversity%20within%20and%20adjacent%20to%20Kibasira%20Swamp%20in%20Kilombero%20Valley%20C%20Tanzania&author=HA.%20Seki&author=DD.%20Shirima&author=CJ.%20Courtney%20Mustaphi&author=R.%20Marchant&author=PK.%20Munishi&journal=Afr%20J%20Ecol&volume=56&issue=3&pages=518-527&publication_year=2018)

Siderius C, Gannon KE, Ndiyoi M, Opere A, Batisani N, Olago D, Pardoe J, Conway D (2018) Hydrological response and complex impact pathways of the 2015/2016 El Niño in Eastern and Southern Africa. *Earth's Future* 6(1):2–22

[CrossRef](https://doi.org/10.1002/2017EF000680) (<https://doi.org/10.1002/2017EF000680>)

[Google Scholar](http://scholar.google.com) (<http://scholar.google.com>)

[/scholar\\_lookup?title=Hydrological%20response%20and%20complex%20impact%20pathways%20of%20the%202015%2F2016%20El%20Ni%C3%B1o%20in%20Eastern%20and%20Southern%20Africa&author=C.%20Siderius&author=KE.%20Gannon&author=M.%20Ndiyoi&author=A.%20Opere&author=N.%20Batisani&author=D.%20Olago&author=J.%20Pardoe&author=D.%20Conway&journal=Earth%20Future&volume=6&issue=1&pages=2-22&publication\\_year=2018](http://scholar.google.com/scholar_lookup?title=Hydrological%20response%20and%20complex%20impact%20pathways%20of%20the%202015%2F2016%20El%20Ni%C3%B1o%20in%20Eastern%20and%20Southern%20Africa&author=C.%20Siderius&author=KE.%20Gannon&author=M.%20Ndiyoi&author=A.%20Opere&author=N.%20Batisani&author=D.%20Olago&author=J.%20Pardoe&author=D.%20Conway&journal=Earth%20Future&volume=6&issue=1&pages=2-22&publication_year=2018)

- Stump D (2010) 'Ancient and backward or long-lived and sustainable?' The role of the past in debates concerning rural livelihoods and resource conservation in Eastern Africa. *World Dev* 38(9):1251–1262  
[CrossRef](https://doi.org/10.1016/j.worlddev.2010.02.007) (<https://doi.org/10.1016/j.worlddev.2010.02.007>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?title=%E2%80%98Ancient%20and%20backward%20or%20long-lived%20and%20sustainable%3F%E2%80%99%20The%20role%20of%20the%20past%20in%20debates%20concerning%20rural%20livelihoods%20and%20resource%20conservation%20in%20Eastern%20Africa&author=D.%20Stump&journal=World%20Dev&volume=38&issue=9&pages=1251-1262&publication_year=2010) ([http://scholar.google.com/scholar\\_lookup?title=%E2%80%98Ancient%20and%20backward%20or%20long-lived%20and%20sustainable%3F%E2%80%99%20The%20role%20of%20the%20past%20in%20debates%20concerning%20rural%20livelihoods%20and%20resource%20conservation%20in%20Eastern%20Africa&author=D.%20Stump&journal=World%20Dev&volume=38&issue=9&pages=1251-1262&publication\\_year=2010](http://scholar.google.com/scholar_lookup?title=%E2%80%98Ancient%20and%20backward%20or%20long-lived%20and%20sustainable%3F%E2%80%99%20The%20role%20of%20the%20past%20in%20debates%20concerning%20rural%20livelihoods%20and%20resource%20conservation%20in%20Eastern%20Africa&author=D.%20Stump&journal=World%20Dev&volume=38&issue=9&pages=1251-1262&publication_year=2010))
- Taylor DM (1990) Late Quaternary pollen records from two Ugandan mires: evidence for environmental change in the Rukiga Highlands of Southwestern Uganda. *Palaeogeogr Palaeoclimatol Palaeoecol* 80:283–300  
[CrossRef](https://doi.org/10.1016/0031-0182(90)90138-W) ([https://doi.org/10.1016/0031-0182\(90\)90138-W](https://doi.org/10.1016/0031-0182(90)90138-W))  
[Google Scholar](http://scholar.google.com/scholar_lookup?title=Late%20Quaternary%20pollen%20records%20from%20two%20Ugandan%20mires%3A%20evidence%20for%20environmental%20change%20in%20the%20Rukiga%20Highlands%20of%20Southwestern%20Uganda&author=DM.%20Taylor&journal=Palaeogeogr%20Palaeoclimatol%20Palaeoecol&volume=80&pages=283-300&publication_year=1990) ([http://scholar.google.com/scholar\\_lookup?title=Late%20Quaternary%20pollen%20records%20from%20two%20Ugandan%20mires%3A%20evidence%20for%20environmental%20change%20in%20the%20Rukiga%20Highlands%20of%20Southwestern%20Uganda&author=DM.%20Taylor&journal=Palaeogeogr%20Palaeoclimatol%20Palaeoecol&volume=80&pages=283-300&publication\\_year=1990](http://scholar.google.com/scholar_lookup?title=Late%20Quaternary%20pollen%20records%20from%20two%20Ugandan%20mires%3A%20evidence%20for%20environmental%20change%20in%20the%20Rukiga%20Highlands%20of%20Southwestern%20Uganda&author=DM.%20Taylor&journal=Palaeogeogr%20Palaeoclimatol%20Palaeoecol&volume=80&pages=283-300&publication_year=1990))
- Thompson PL, Rayfield B, Gonzalez A (2017) Loss of habitat and connectivity erodes species diversity, ecosystem functioning, and stability in metacommunity networks. *Ecography* 40(1):98–108  
[CrossRef](https://doi.org/10.1111/ecog.02558) (<https://doi.org/10.1111/ecog.02558>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?title=Loss%20of%20habitat%20and%20connectivity%20erodes%20species%20diversity%2C%20ecosystem%20functioning%2C%20and%20stability%20in%20metacommunity%20networks&author=PL.%20Thompson&author=B.%20Rayfield&author=A.%20Gonzalez&journal=Ecography&volume=40&issue=1&pages=98-108&publication_year=2017) ([http://scholar.google.com/scholar\\_lookup?title=Loss%20of%20habitat%20and%20connectivity%20erodes%20species%20diversity%2C%20ecosystem%20functioning%2C%20and%20stability%20in%20metacommunity%20networks&author=PL.%20Thompson&author=B.%20Rayfield&author=A.%20Gonzalez&journal=Ecography&volume=40&issue=1&pages=98-108&publication\\_year=2017](http://scholar.google.com/scholar_lookup?title=Loss%20of%20habitat%20and%20connectivity%20erodes%20species%20diversity%2C%20ecosystem%20functioning%2C%20and%20stability%20in%20metacommunity%20networks&author=PL.%20Thompson&author=B.%20Rayfield&author=A.%20Gonzalez&journal=Ecography&volume=40&issue=1&pages=98-108&publication_year=2017))
- Trauth MH, Deino AL, Bergner AG, Strecker MR (2003) East African climate change and orbital forcing during the last 175 kyr BP. *Earth Planet Sci Lett* 206(3–4):297–313  
[CrossRef](https://doi.org/10.1016/S0012-821X(02)01105-6) ([https://doi.org/10.1016/S0012-821X\(02\)01105-6](https://doi.org/10.1016/S0012-821X(02)01105-6))  
[Google Scholar](http://scholar.google.com/scholar_lookup?title=East%20African%20climate%20change%20and%20orbital%20forcing%20during%20the%20last%20175%20kyr%20BP&author=MH.%20Trauth&author=AL.%20Deino&author=AG.%20Bergner&author=MR.%20Strecker&journal=Earth%20Planet%20Sci%20Lett&volume=206&issue=3%E2%80%934&pages=297-313&publication_year=2003) ([http://scholar.google.com/scholar\\_lookup?title=East%20African%20climate%20change%20and%20orbital%20forcing%20during%20the%20last%20175%20kyr%20BP&author=MH.%20Trauth&author=AL.%20Deino&author=AG.%20Bergner&author=MR.%20Strecker&journal=Earth%20Planet%20Sci%20Lett&volume=206&issue=3%E2%80%934&pages=297-313&publication\\_year=2003](http://scholar.google.com/scholar_lookup?title=East%20African%20climate%20change%20and%20orbital%20forcing%20during%20the%20last%20175%20kyr%20BP&author=MH.%20Trauth&author=AL.%20Deino&author=AG.%20Bergner&author=MR.%20Strecker&journal=Earth%20Planet%20Sci%20Lett&volume=206&issue=3%E2%80%934&pages=297-313&publication_year=2003))
- United Nations (2015) Sustainable Development Goals.  
<https://sustainabledevelopment.un.org/sdgs>  
(<https://sustainabledevelopment.un.org/sdgs>), Accessed 28 Nov 2018
- Verschuren D, Laird KR, Cumming BF (2000) Rainfall and drought in equatorial east Africa during the past 1,100 years. *Nature* 403(6768):410–414  
[CrossRef](https://doi.org/10.1038/35000179) (<https://doi.org/10.1038/35000179>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?title=Rainfall%20and%20drought%20in%20equatorial%20east%20Africa%20during%20the%20past%201%2C100%20years&) ([http://scholar.google.com/scholar\\_lookup?title=Rainfall%20and%20drought%20in%20equatorial%20east%20Africa%20during%20the%20past%201%2C100%20years&](http://scholar.google.com/scholar_lookup?title=Rainfall%20and%20drought%20in%20equatorial%20east%20Africa%20during%20the%20past%201%2C100%20years&))

[author=D.%20Verschuren&author=KR.%20Laird&author=BF.%20Cumming&journal=Nature&volume=403&issue=6768&pages=410-414&publication\\_year=2000](https://doi.org/10.1007/978-3-030-14857-7_18)

WoldeGabriel G, Olago D, Dindi E, Owor M (2016) Genesis of the East African Rift system. In: Schagerl M (ed) Soda lakes of East Africa. Springer, Berlin, pp 25–59  
[Google Scholar \(http://scholar.google.com/scholar\\_lookup?title=Genesis%20of%20the%20East%20African%20Rift%20system&author=G.%20WoldeGabriel&author=D.%20Olago&author=E.%20Dindi&author=M.%20Owor&pages=25-59&publication\\_year=2016\)](https://scholar.google.com/scholar_lookup?title=Genesis%20of%20the%20East%20African%20Rift%20system&author=G.%20WoldeGabriel&author=D.%20Olago&author=E.%20Dindi&author=M.%20Owor&pages=25-59&publication_year=2016)

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