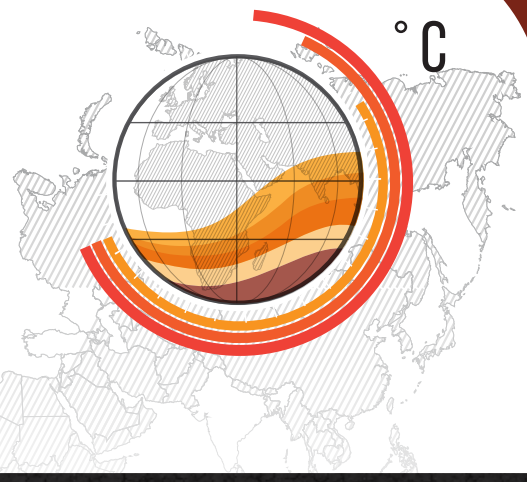
WHAT GLOBAL WARMING OF 1.5°C AND HIGHER MEANS FOR BOTSWANA



The Paris Agreement has a goal of limiting global warming well below 2°C, ideally 1.5°C. Understanding the local-level impacts of these global temperature targets is crucial for informing climate change adaptation needs and actions. To date, mitigation pledges by nations fall far short of what is needed, with the world on track to warm by 3.2°C by the end of the century[1].

For Botswana, local warming and drying will be greater than the global average. So, even a 1.5°C increase in global temperature will have severe local impacts, negatively affecting water supply, agriculture, health, and other vulnerable sectors. The 1.5°C threshold could be breached within the next decade, and the 2°C threshold the decade after[2]. This means there is an urgent need to accelerate Botswana's adaptation responses.

LOCAL IMPACTS IN BOTSWANA

		GLOBAL WARMING ABOVE PRE-INDUSTRIAL LEVELS			
		1.5°C	2°C	2.5°C	3°C
Projected climate changes[3]	CLIMATE				
	Mean temperature (°C)	▲ 2.2	▲ 2.8	▲ 3.5	▲ 4.2
	Heat waves (days)	▲ 43	▲ 72	▲ 105	▲ 136
	Annual rainfall	▼ 5%	▼ 9%	▼ 10%	▼ 11%
	Heavy rainfall (days)	▼ 2	▼ 3	▼ 3	▼ 4
	Dry days	▲ 10	▲ 17	▲ 24	▲ 28
Estimated impacts[4]	WATER				
	Okavango River[5] (streamflow)	▼ 6%[6]	▼ 12%[6]	▼ 18%[6]	▼ 24%[6]
	Limpopo Catchment[7] (runoff)	▼ 26%	▼ 36%	▼ 46%	▼ 56%
	AGRICULTURE				
	Maize[8] (yield)	▼ 23%	▼ 35%	▼ 46%[6]	▼ 58%[6]
	Sorghum[8] (yield)	▼ 11%	▼ 17%	▼ 23%[6]	▼ 29%[6]
	Water for livestock[9] (cost of pumping)	▲ 15%	▲ 19%	▲ 22%	▲ 24%
	HEALTH				
	Malaria[10] (months of risk)	▼ 12%[6]	▼ 16%[6]	▼ 29%	▼ 29%[11]
	Heat stress[12] (number of days of exposure)	▲ 20	▲ 20	▲ 40	▲ 40

[1] Climate Action Tracker. https://climateactiontracker.org/global/cat-thermometer.
[2] Nkemelang, T. et al. 2018. Determining what global warming of 1.5°C and higher means for the semi-arid regions of Botswana, Namibia, Ghana, Mali, Kenya and Ethiopia: A description of ASSAR's methods of analysis. https://bit.ly/2yHbWPf.
[3] Based on climate modelling by T. Nkemelang. University of Cape Town, South Africa.
[4] Based on data analysis by R.Bouwer. University of Cape Town, South Africa.
[5] Andersson, L., Wilk, J., Todd, M.C., Hughes, D.A., Earle, A., Kniveton, D., Layberry, R. & Savenije, H.H. 2006. Impact of climate change and development scenarios on flow patterns in the Okavango River. *Journal of Hydrology*. https://doi.org/10.1016/j.jhydrol.2006.04.039.
[6] Extrapolated assuming a linear progression with no threshold being reached.
[7] Zhu, T. and Ringler, C. 2010. *Climate change implications for water resources in the Limpopo River Basin* (No. 961). International Food Policy Research Institute (IFPRI).
[8] Chipanshi, A.C., Chanda, R. and Totolo, O. 2003. Vulnerability assessment of the maize and sorghum crops to climate change in Botswana. *Climatic Change*. https://doi.org/10.1023/B:CLIM.0000004551.55871.eb.
[9] Masike, S. and Urich, P. 2009. The projected cost of climate change to livestock water supply and implications in Kgatleng District, Botswana. *World Journal of Agricultural Sciences*. https://www.idosi.org/wjas/wjas5(5)/13.pdf.
[10] Tanser, F.C., Sharp, B. and le Sueur, D. 2003. Potential effect of climate change on malaria transmission in Africa. *The Lancet*. https://doi.org/10.1016/S0140-6736(03)14898-2.
[11] Note: Interestingly, above 3˚C a critical threshold is reached, and malaria risk increases by 36%.
[12] Garland, R.M., Matooane, M., Engelbrecht, F.A., Bopape, M.J.M., Landman, W.A., Naidoo, M., Merwe, J.V.D. and Wright, C.Y. 2015. Regional projections of extreme apparent temperature days in Africa and the related potential risk to human health. *International Journal of Environmental Research and Public Health*. https://dx.doi.org/10.3390%2Fijerph121012577.

ASSAR
Adaptation at Scale in Semi-Arid Regions

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IMPACTS OF GLOBAL WARMING THRESHOLDS ON BOTSWANA'S CLIMATIC ZONES

	ARID SOUTH				ARID NORTH				SEMI-ARID SOUTH				SEMI-ARID NORTH				BOTSWANA OVERALL			
	1.5°C	2°C	2.5°C	3°C	1.5°C	2°C	2.5°C	3°C	1.5°C	2°C	2.5°C	3°C	1.5°C	2°C	2.5°C	3°C	1.5°C	2°C	2.5°C	3°C
Annual rainfall (%)	-6	-8	-11	-15	-8	-10	-9	-11	-5	-9	-10	-11	-6	-9	-10	-11	-5	-9	-10	-11
Duration of dry spells (days)	+9	+15	+21	+27	+11	+18	+23	+30	+9	+16	+20	+25	+13	+19	+24	+29	+10	+17	+24	+28
Duration of wet spells (days)	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-2	-2	-1	-1	-1	-1
Heavy rainfall days (>10mm/day)	-1	-2	-2	-3	-2	-3	-3	-3	-1	-2	-3	-3	-2	-3	-3	-3	-2	-3	-3	-4
Extreme heavy rainfall days (>20mm/day)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amount of rain in heavy rainfall events (%)	+4	-2	-4	-7	+3	0	+4	+6	+1	-1	+1	-3	+4	+2	+4	+7	+5	0	0	+1
Amount of rain in extremely heavy rainfall events (%)	+16	+8	+9	+3	+19	+19	+34	+32	+13	+16	+21	+21	+21	+20	+32	+35	+17	+15	+22	+20
Amount of rain in highest rainfall day (%)	+3	+3	+2	+2	+5	+5	+8	+9	+3	+5	+7	+7	+5	+7	+9	+9	+4	+4	+6	+8
Amount of rain in highest five consecutive rainfall days (%)	+1	0	0	-1	+2	+2	+7	+4	+2	+2	+4	+1	+3	+2	+5	+4	+2	+2	+3	+2
Temperature change (°C)	+2.1	+3.0	+3.6	+4.5	+2.2	+2.9	+3.5	+4.2	+2.2	+2.8	+3.4	+4.2	+2.1	+2.9	+3.6	+4.2	+2.2	+2.8	+3.5	+4.2
Number of hot days (>90th percentile)	+71	+105	+139	+168	+72	+105	+131	+161	+66	+98	+126	+156	+79	+116	+148	+180	+73	+108	+136	+169
Number of hot nights (>90th percentile)	+71	+107	+133	+163	+78	+116	+151	+185	+74	+109	+143	+177	+87	+128	+170	+203	+78	+119	+149	+182
Number of cold days (<10th percentile)	-27	-32	-35	-39	-27	-33	-36	-38	-25	-31	-35	-37	-30	-34	-38	-40	-28	-33	-36	-38
Number of cold nights (<10th percentile)	-37	-41	-45	-47	-37	-42	-44	-47	-37	-41	-44	-47	-40	-45	-46	-48	-39	-42	-45	-48
Duration of heat waves (days)	+39	+66	+97	+129	+42	+70	+101	+134	+40	+63	+90	+120	+48	+83	+121	+156	+43	+72	+105	+136