

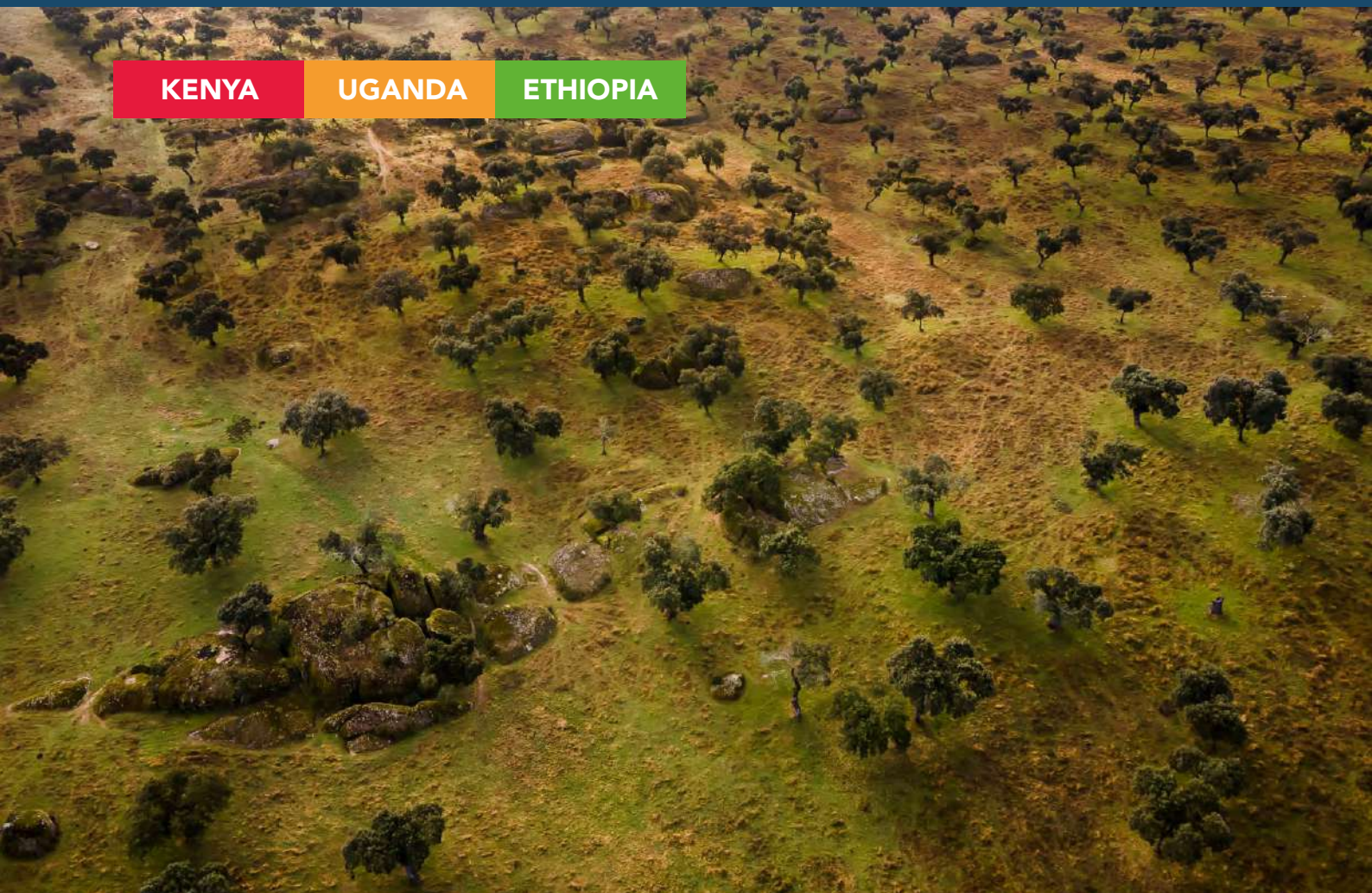


Priming Private Sector Investment in Climate Adaptation Innovations in East Africa

KENYA

UGANDA

ETHIOPIA



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Foreword

East Africa has lived through devastating climate change since 2020, putting 60 million people in need of urgent humanitarian assistance. Three years of drought and two years of locusts have been followed, when rain finally came, by flooding that led to the highest number of disease outbreaks in the region this century.



These blights have been a direct consequence of rainfall patterns that have been distorted by climate change, alongside rising heat that has reduced water capture and caused its own consequences. Further knock-on impacts have stolen additional lives, through air pollution, as hot air carries far higher levels of the particulates toxic to humans; through the destruction of crops by heat-stoked pests breeding up to 40 times more generations a year; and through a surge in water-borne diseases and poor sanitation caused by water scarcity and flooding.

Indeed, the region has suffered so severely that, alongside the recent global spike in intense heat, droughts and wildfires, climate change has now been redefined by UNEP as a current emergency, instead of a looming one. Yet, attending to the adaptation needed to cope with this weather disruption is going too slowly, says UNEP, with the climate debate still concentrated on mitigating climate change by reducing emissions driving the planet's

greenhouse effect.

With Africa now losing millions of livelihoods and lives a year to climate change, adaptation is urgently needed. Kenya and Ethiopia have been the hardest hit in the region, while Uganda has recently embraced climate change adaptation with vigour, driving our choice of these three nations as the focus for this report. Yet, as these countries seek urgent solutions, the vision of catalytic public sector investment on the continent driving a rush of private sector engagement has failed to materialise.

Private investment flows into Ethiopia accounted for just 0.56 percent of the country's climate finance needs in 2018, according to the Climate Policy Initiative. A more vigorous private sector pipeline in Kenya still saw only 4 percent of its climate needs covered in the same year. While, in Uganda, the government has reported scant visibility, to date, of any private climate inflows. This has raised profound issues around the limits on private capital inflows set by investors' perceptions of Africa as high risk.

Our aim with this report, thanks to the funding provided by the Lemelson Foundation for its development, has been to seed local initiatives and grass-root growth in adaptation businesses. On this basis, we have set out to identify the role that innovator entrepreneurs can play in accelerating adaptation for East Africa's population and the challenges they face in securing investment in scalable business models.

The report has prioritised physical technologies, which must necessarily contribute to climate adaptation alongside the advanced information capacities provided by digital technologies. Physical technologies are often harder to move into commercialisation at levels that achieve a high impact, requiring investors, regulators and support programmes to be intentional in enabling them.

Aims and Methodology



This report aims to identify the needs for physical climate adaptation technologies in East Africa, the investment opportunities, and the practical routes to investment.

Within East Africa, we focused our research on Ethiopia and Kenya as the two countries most impacted by climate change, and on Uganda, which has lagged in adaptation and is the world's 10th most vulnerable country to the impacts of climate change, but the 35th in terms of preparedness.

The methodology has been designed to highlight existing and viable pathways to high-impact investments in climate adaptation innovation, as well as critical obstacles to climate adaptation investment.

To conduct this analysis, we began with a literature review covering three areas of enquiry:

- (i) the specific impact of climate change in each country and the identification of the sectors most affected;
- (ii) the emerging physical technology innovations that resolve or reduce the impact of climate change; and
- (iii) the investment infrastructures and business models available to channel investments into these areas.

Following from the findings of the literature review, we identified agriculture, health and infrastructure as the sectors where climate change is now causing the most mortalities and damage to health and livelihoods in the region.

We then conducted a quantitative survey to deepen our understanding of the impact on individuals of climate change in the region. The poll of 5,000 respondents, questioned 2,000 participants in each of Kenya, 2000 in Uganda and 1,000 in Ethiopia, around their awareness of climate change, its impacts on them, and their adaptation to date. A semi-structured questionnaire was used to collect data via GeoPoll's proprietary Mobile Web survey platform. The questionnaire included 29 questions and respondents only qualified for the survey if they were aware/had heard of climate change before.

The quantitative research phase was followed by a qualitative study to map the region's entrepreneurial investment potential and channels. For this, we conducted 34 one-hour interviews with regional climate change specialists, investors, incubation hubs and accelerators. These interviews investigated the breadth, depth and functionality of the entrepreneur investment ecosystem, reviewed the criteria, priorities and interests of investors, and established their exposure to and pick-up of climate adaptive physical technologies in each country.

Executive Summary

Climate change has gained sharply more attention in recent years as its pace has accelerated and its impacts have become pervasive and more damaging. But the vital focus on preventing a climate cataclysm through reducing carbon emissions has seen the world's most vulnerable countries move into climate crises with scant attention to ways of preventing their plight.

This emphasis on carbon-reducing climate emission beside a relative neglect of life-protecting climate adaptation has become a North versus South point of tension, sparking disputes at COP26 and COP27, and now placing the need to 'correct course' on adaptation finance firmly onto the COP28 agenda.

Yet the costs are set to be huge. The Climate Policy Initiative estimated in 2022 that Africa's climate financing needs were running at \$250bn a year and East Africa's at \$82bn. These figures dwarf the \$100bn a year pledged by developed nations in 2009 as a total climate investment flow into all the world's developing nations, yet even that pledge has never yet been achieved. Moreover, public funds are now under added pressure following the Covid 19 pandemic.

However, private finance inflows are far smaller still, covering just 0.56 percent of climate finance needs in Ethiopia, for example. Yet, the region is in acute need, with 60 million people now in need of urgent humanitarian assistance as a result of droughts, agricultural failures, locust swarms, floods and heat. The region's rain patterns have changed, bringing frequent drought, and irregular and truncated rainy seasons. Temperatures have risen, drying out soils and resulting in rains that run off into floods. Large regions are desertifying, as farmers lose livestock and crops, pests and diseases gather pace, and the fabric of energy, water and road infrastructure is destroyed.

Against this backdrop, the Intergovernmental Panel on Climate Change has declared that it is now urgent to empower and enable East Africa to develop its own climate solutions.

To that end, this report reviewed the climate impact business opportunities in the most affected sectors, agriculture, health and infrastructure, to assess their potential for entrepreneurial businesses. The scale of the damage and destruction that such businesses could prevent was considered, alongside the range and nature of emerging technologies, and their stage of development.

Each area was also reviewed for barriers to entry and its revenue potential to establish whether it offered the prospect of supporting sustainable or profitable businesses.

On this basis, four categories of business sectors were identified, which together could deliver a viable basis for resilience in the face of climate change:

- 1 The top opportunities are in water creation, soil fertility, air pollution and sanitation, which have the most emerging technologies, clearest business models and prospects of sustainability, and highest impact;
- 2 Spaces to watch, in road technologies, heat stress, vector-borne diseases and crop cooling, where new technologies are pre-market, the climate impact is somewhat smaller but growing, or business models are not yet established;
- 3 Steady growers, in hydroponics, water use, and local energy, where new technologies are already on the market, being delivered by sustainable businesses, but with plenty of scope for expansion; and
- 4 Not impossible: in seed and livestock adaptation and pest control, where the impact would be very high, but there are barriers to entrepreneurial innovation and entry.

However, the number of businesses emerging in these new sectors remains minimal, as investors grapple with an array of structural issues:

- The investment ecosystems for all entrepreneurs in Kenya, Uganda and Ethiopia have relatively limited market linkages, as well as excessive discovery costs compared with the extremely small investment sizes.
- Many climate-oriented funds are bound by risk-driven preferences for renewable energy investment and digital businesses. These frequently preclude physical climate adaptation technologies.
- The business support and funding community is also more geared towards climate mitigation, driven by financiers' priorities and its limited awareness and blurred definitions of climate adaptation.

On this basis, engineering a stepchange in climate adaptation and benefits in East Africa will require comprehensive awareness raising on the breadth of the climate impact in the region. This currently extends far beyond the immediate crop losses caused by drought and the damage to homes and land from floods.

Examples of the kind of knock-on impacts that the changing climate is delivering include the accelerated cracking of bitumen on road surfaces in increasingly fierce and regular heat spikes. These cracks let rain in below the surface, washing away stones and soil and creating potholes, which then increase road accidents and make it harder to move agricultural produce to market, and essentials to rural communities.

Likewise, a predominantly urban climate change impact is through sewage, with many low-income urban areas using pit latrines that get emptied into streets and homes on flooding, causing outbreaks of diseases spread by effluent, such as cholera.

These and countless other impacts, including increased malaria and crop pests - as whole classes of insects, bacteria and viruses thrive in the heightened temperatures and swings from drought to inundation - are all costing lives, incomes and economic growth.

Yet there has been little focus on the full breadth of these climate change interfaces, which is constraining the private sector response. Potential entrepreneurs with an innate understanding of what can work locally are yet to move, as a groundswell, into developing relevant and appropriate pollution gobblers or soil moisturising solutions. Likewise, so long as climate information remains the preserve of a tight circle of specialists, in health, agriculture or infrastructure, effectively operating in silos, cross-discipline solutions also remain out of reach.

It is, therefore, vital that information on climate impacts now moves into mainstream conversations and policy debates.

The cross-sectoral development of climate adaptation businesses further requires specific and relevant solutions to the risk management constraints on the financial sector. Examples could include advanced knowhow support to prevent business failures, and the generation and broadcast of data demonstrating the potential for relatively secure investments.

Entrepreneurial support structures in Kenya, Uganda and Ethiopia are creating businesses and skilled managers, but there are only a handful of hubs explicitly focused on climate action, while the support, networks and financing that exist are not organised around addressing problems, such as adapting to climate change. Securing a far greater scale of engagement around climate solutions will require the integration of a climate adaption lens into existing programmes and sectors, from agriculture to social programmes, as well as an expanded ecosystem providing non-financial support. Moreover, methods such as e-learning, certification, and partnerships with the Training and Vocational Education sector offer the potential for greater efficiency as an extension of existing programmes, than can be achieved by launching new initiatives.



On this basis, we recommend:

01 — The launch of comprehensive national and local information campaigns, driven by government entities and private sector organisations, to raise awareness on climate impacts and their business solutions, attract entrepreneurs, and advance climate innovation markets;

.....

02 — The development of an investment-sector, collective website listing all areas where business solutions are needed to address climate impacts in East Africa, offering crowd-sourced listings of entrepreneurs seeking to engage in climate businesses, and providing a knowledge base on climate businesses under development, as well as pan-African insights on innovative business models that could apply in adaptation. The website would aim to ease the difficulty for investors and support networks in identifying potential candidates for support, and mobilise, inspire and facilitate climate adaptation entrepreneurs;

.....

03 — The development of a public-private initiative, potentially with an organisation such as KenTrade, KenInvest, or Financial Sector Deepening and a firm within the financial or investment ecosystem, to produce an annual business risk report on climate adaptation businesses, providing an accurate assessment of the drivers, markers, and levels of business risks for investors in such businesses in East Africa, with metrics and comparatives;

.....

04 — The pursuit by African angel networks, foundations, philanthropic and other investment organisations of blended finance, with partnerships that catalyse private investment in climate adaptation, either by offsetting risk or by increasing earning potential, through platforms that engage a variety of capital providers, following the models of platforms such as Prime Coalition and affiliate funds like Azolla, in climate mitigation, to draw in a wider pool of investors into climate adaptation.

.....

05 — Partnerships and development of all existing business knowledge programmes, through the Training and Vocational Education sector, existing hubs and accelerators, and other knowledge-building programmes, to pool and extend curricula and training resources, with the aim of driving increased reach to potential entrepreneurs.



Chapter One:

Introduction



Priming private
sector investment
in climate adaptation
innovations In East Africa

Introduction

Climate change is shaping our future, as we clog up our atmosphere with greenhouse gases, preventing the escape of heat from the Earth's surface, melting the ice at the planet's poles, raising sea levels, and disrupting weather norms. Yet, it is a passage of cause and effect that has generated a dual agenda.

By far the largest part of the climate discourse is around the cause. Vital, loud, and growing, the debate around climate mitigation seeks to reduce the amount of carbon dioxide we release in a bid to extend the timespan of viable life on our planet.

Then, there is a much smaller agenda, climate adaptation, which covers how we cope with the impacts of climate change that are already underway. This space has been populated predominantly by on-the-ground initiatives with smallholder farmers in Africa and Asia, drawing them into water harvesting and fertiliser changes to improve soil fertility.

In the African context, this imbalance of attention and inputs is now proving acutely painful. Africa accounts for around 3 percent of the world's greenhouse emissions, but is home to 16 of the 20 countries rated as most vulnerable to climate change by the Notre Dame Global Adaptation Index. This vulnerability is, furthermore, now delivering severe impacts, with 20 million to 30 million people in Ethiopia, Kenya and Somalia currently facing acute food insecurity as a result of drought.

This has generated North-South division in increasingly strident debate at the world's global environmental summits, as developing nations suffer many of the impacts of climate change, while the developed world focuses almost exclusively on the challenge of cutting carbon emissions.

At Cop27, this tension brought promises of new funds to help deal with extreme climate events, such as droughts and floods. But Cop 28, due in November 2023, has set a new agenda, declaring:

"We must respond to the facts. We need to reduce emissions by 43% by 2030 and course correct on adaptation, finance and loss and damage."

In East Africa, the need for course correction on adaptation is acute. It is estimated that 39m people are suffering in the region due to drought. But 73m are being adversely impacted by the rise in heat, which barely enters the discourse.

The heat is accelerating the growth of pests and bacteria, killing through heat stress, and drying out soils through increased evaporation, meaning they can't absorb new water and rain turns to floods. Those floods then empty the pit latrines into waterways, causing cholera outbreaks - and the list goes on.

In 2022, UNEP declared that the impact of climate change in the developing world is now a climate emergency. East Africa is on the frontline of that emergency. With its weather system driven by sea temperatures in the Pacific and Indian Oceans, it experiences a greater variation in rainfall than any other region in the world. This has, effectively, placed it in the vanguard of climate impact, making it a gauge to the current maximum impact of climate change.

As a result, the last three years have seen it suffer severe drought, the largest locust swarms for generations, flooding, and surging human, animal, and crop diseases, all of which are boosted by higher temperatures. Its roads and bridges are being ripped apart by weather extremes, its water and energy supplies are being depleted by rising temperatures and erratic rainfall, and over 60 million of its people have been pushed into poverty, starvation, and disease.



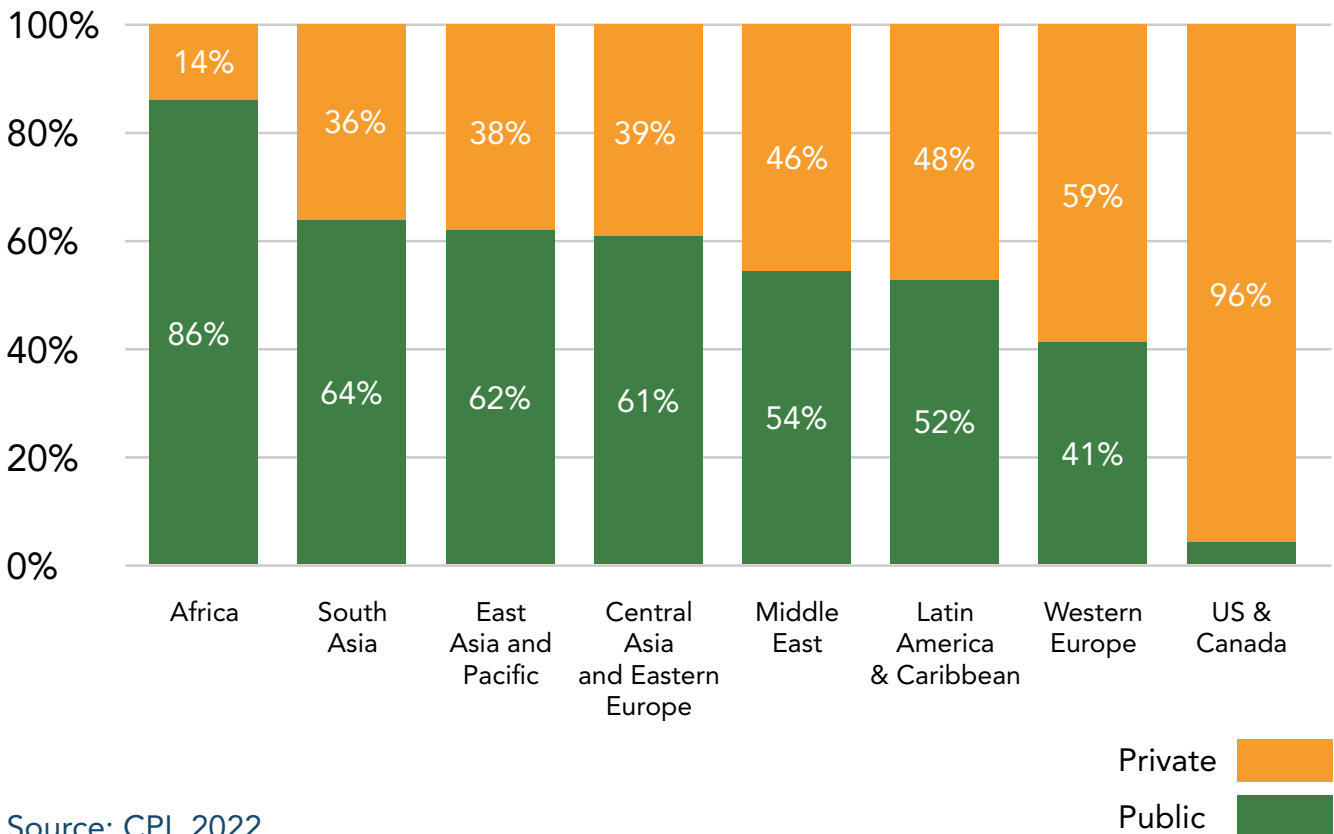
However, the cost of protecting itself from these changes will be colossal in nations that are particularly vulnerable to shifts in the weather. Estimates on the funding needs for climate adaptation in Africa, and in each of the East African nations, far exceed these country's financial capacities. The adaptation also plays to existing development issues, which have increased their exposure. Nearly all of East Africa's agriculture is rain-fed. Most of the families relying on that agriculture exist at a marginal or subsistence level. The region already suffers more acutely from mosquito-borne diseases than most of the rest of the world, and it was already chasing a range of relevant sustainable development goals with mixed success.

Yet, with a huge adaptation emergency now before it, international funding has, so far, been scanty. From 2009, the developed world pledged \$100bn to developing nations' change adaptation and mitigation. The flows have never reached this figure, with the Climate Policy initiative reporting that funding by 2020, which was higher than in 2019 or any previous year, amounted to just \$29.5bn. The needs have also grown, most recently to an estimated \$250bn a year for Africa, and \$82bn a year for East Africa, which by 2020. was receiving just \$10bn a year.

In this context, new technologies can make funding go much further, which is vital as the competition intensifies for public funding. Donor governments are now having to increase their funding of their own climate adaptation, even as they grapple with the costs of post-Covid debt and war in Europe, seeing the chances of an eight-fold increase in adaptation funding to East Africa recede rather than grow.

Yet, these public flows contribute 86 percent of the climate finance to Africa, with the flows of private sector climate finance representing the smallest proportion of total flows in Africa of anywhere in the world, as shown in Figure 1, below.

Figure 1: Share of private climate Finance to total climate finance by region (2019/2020 average)



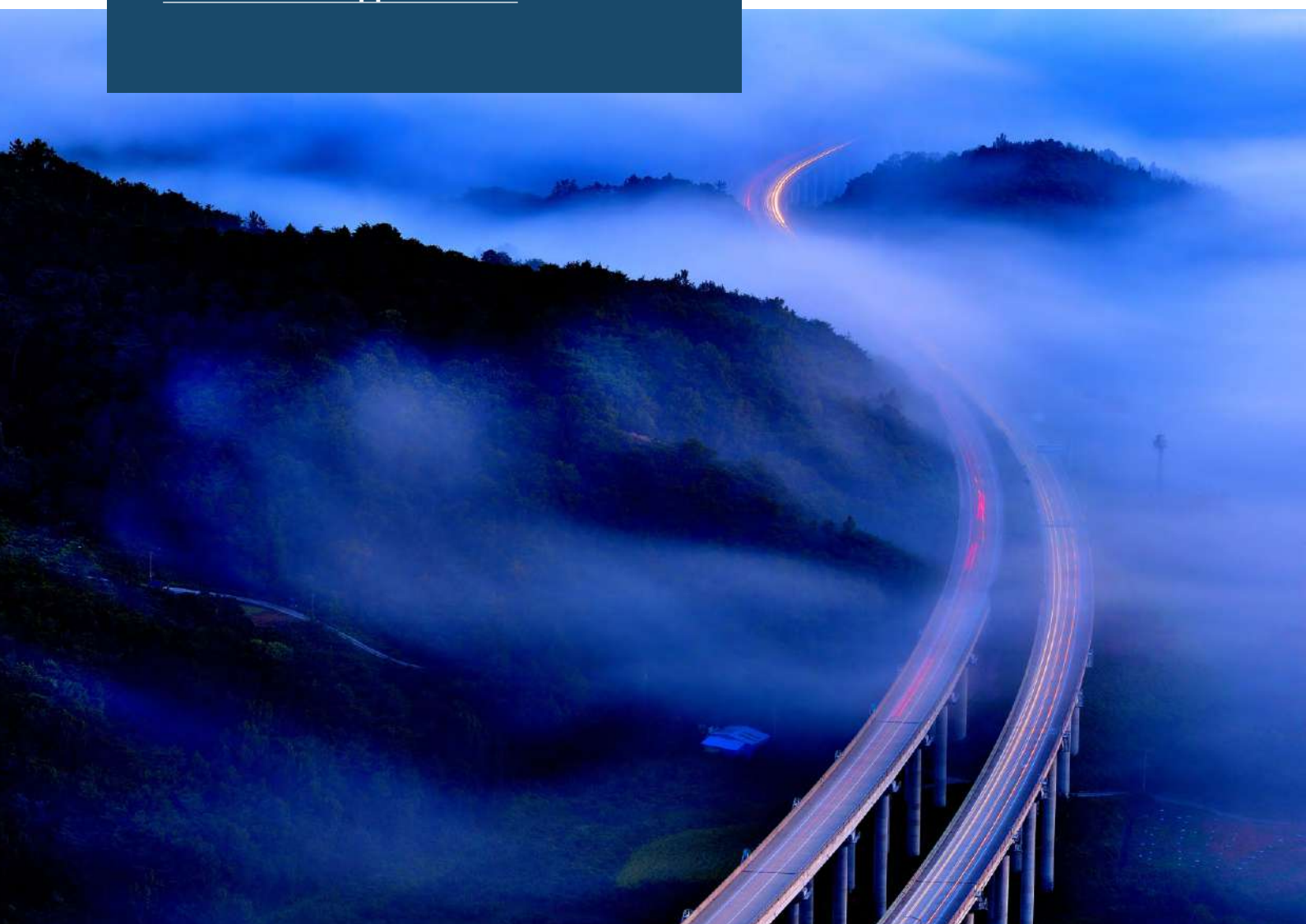
Source: [CPI, 2022](#)

This has prompted the Intergovernmental Panel on Climate Change to declare:



The region urgently needs to be empowered and enabled in building its own solutions. For, alongside the contributions of governments and donors, East Africa needs sustainable private sector businesses working as an engine of change in resolving the region's shortages of food, water, power and economic opportunities.

With a view to stimulating targeted innovation that can secure this aim, Chapter 2 lays out the specific impacts of climate change in the region, highlighting the three sectors where the impact is now the greatest, in agriculture, health and infrastructure. In Chapter 3, we then review the types of innovations that are providing new adaptation solutions in these areas, before looking in Chapter 4 at the current nature of private sector climate investment in Ethiopia, Kenya and Uganda, the entrepreneurial support ecosystems, and the current constraints on investment growth.





Climate
Change in
East Africa



Chapter Two:

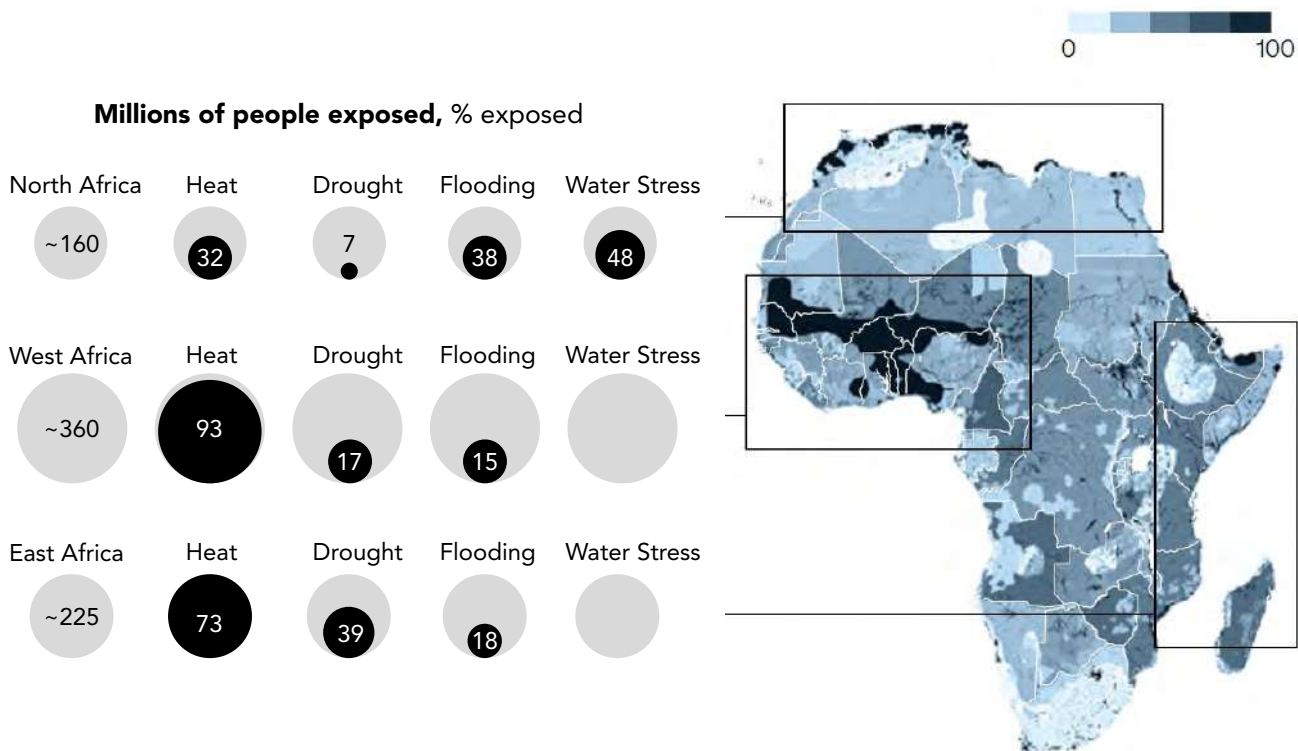
Climate Change in East Africa



Priming private
sector investment
in climate adaptation
innovations In East Africa

East Africa has been disproportionately affected by the global buildup of greenhouse gases in the atmosphere. Much of the region has already exceeded the global target of a 1.5-degree increase in average temperatures since pre-industrial times by 2030 and is forecast to be as much as 4.3 degrees higher by 2100. The increased heat is drying out soils by evaporating more rain and groundwater, leaving the ground unable to absorb heavy downpours and generating frequent flash floods. In all three countries under review, desertification is also accelerating, taking thousands of hectares a year of productive land.

Figure 2: People exposed to climate hazards under a 2°C warming scenario by 2050



Source: "Green Africa: A growth and resilience agenda for the continent" by McKinsey & Company, based on IHS Market; International Labour Organisation(ILO); NASA Earth Exchange; National Center for Atmospheric Research Integrated Assessment Modeling; Socioeconomic Data and Applications Center; Woodwell Climate Research Center; World Resources Institute(WRI)

Millions of people exposed to climate stressors, [Global Center on Adaptation, 2022](#)

At the same time, rainfall in East Africa varies more from year to year than almost anywhere in the world driven by the irregular warming (El Nino) and cooling (La Nina) of the eastern equatorial Pacific Ocean, and the sea surface temperature of the Indian Ocean. Depending on which month these temperature changes happen, East Africa moves into drought or cyclones.

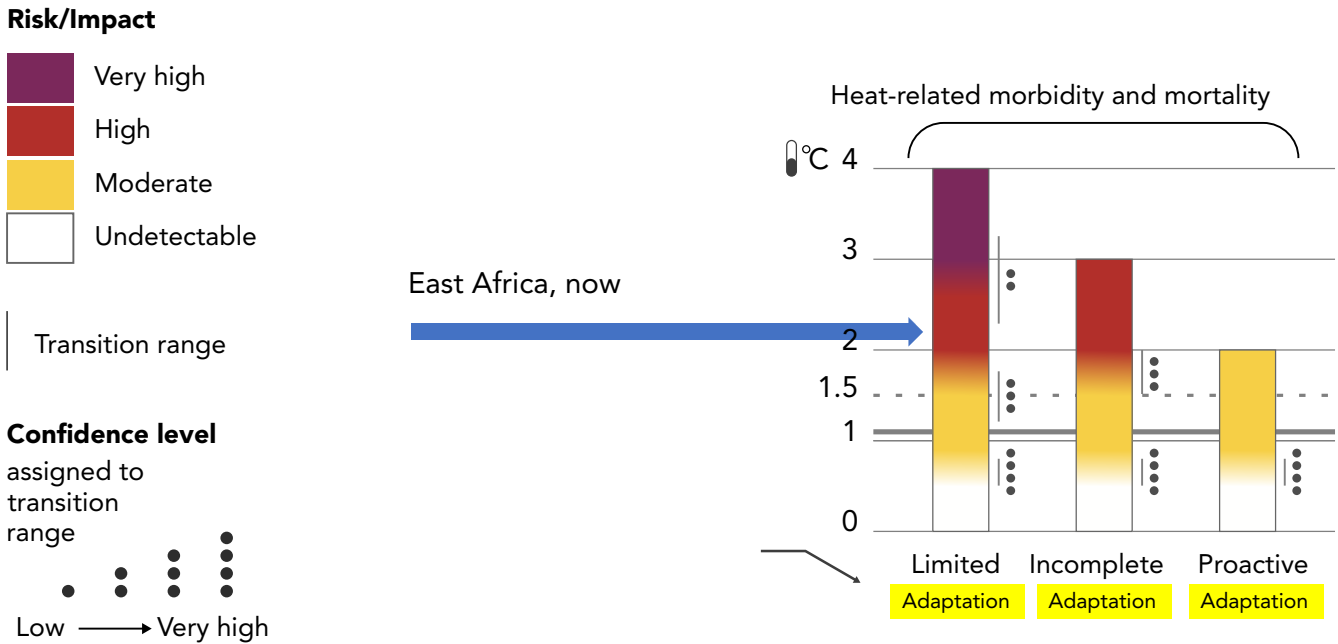
With climate change accelerating rapidly and polar ice sheets melting at more than six times the rate of the mid-1990s, these changes in sea temperatures and currents are growing.

The consequent disruption in East Africa’s rainfall is one of the region’s harshest impacts from climate change, already causing many thousands of deaths a year, and moving millions of East Africans into food insecurity, through:

- Floods
- Droughts
- Cyclones
- Irregular seasons that ruin crops
- Soil erosion.

In 35 years, from 1981, East African agricultural regions typically experienced from 43 to 47 months of drought. At the same time, temperature increases have moved the region into extreme risk of deaths and disease, with Figure 3, below illustrating its current climate risk position.

Figure 3: Heat related morbidity and mortality rate in East Africa



The difference that proactive adaptation is expected to make to the risk of heat-related morbidity and mortality, at different levels of temperature rise, IPCC, 2023

The relationship between the rising heat and the surging **deaths and disease** in East Africa is driven by multiple dynamics. The greater heat has accelerated the lifecycle of (cold-blooded) insects so they are now breeding more generations a year, leading to exponential expansions in their populations. Added to that, the repeated swings from droughts to cyclones create perfect conditions for swarms, such as locusts, with the region suffering its largest locust invasion for generations during 2020 and 2021. Mosquitoes and ticks are multiplying, spreading more malaria, dengue fever, chikungunya, yellow fever and West Nile fever, while higher temperatures are driving the spread of more bacteria and diseases to humans, livestock and plants. At the same time, the combination of frequent flooding alongside rising water scarcity and reduced sanitation is driving a surge in water-borne diseases such as cholera and dysentery.

Heat stress and air pollution are also adding to the mortality rates, with the region’s slum shacks with tin roofs now regularly heating to above 40 degrees, where the elderly and infants start suffering potentially mortal heat stress from 35 degrees.

Likewise, air pollution has emerged as one of the region’s leading killers. The indoor burning of wood for cooking creates indoor pollution, while poorly controlled industries, vehicles, open burning and mounting dust levels create outdoor pollution. Hot air has the capacity to carry a much greater level of pollution particulates, meaning that pollution levels have surged, leading to a swelling in respiratory diseases.

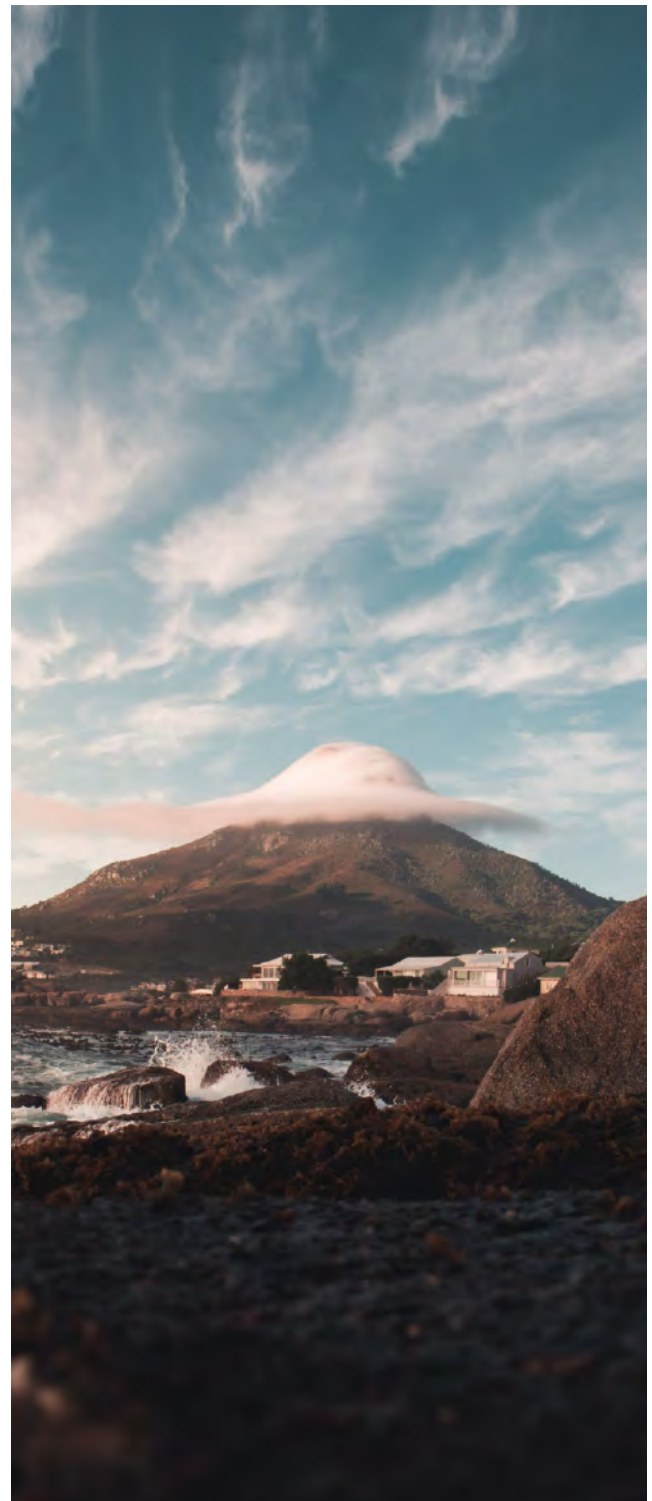
In addition, **infrastructure** is bowing in the harsher weather. Sun-beaten asphalt on roads is melting and cracking, allowing rain to seep in and erode the under-soil, causing potholes.

Dirt tracks are becoming dust bowls, and both types of roads, as well as bridges, are being rendered unusable by floods. The loss of these thoroughfares is preventing the passage of goods and reducing access to vital services. Water supplies are also failing and the rising water scarcity is impacting energy supplies, with much of the region powered by hydropower.

In **agriculture**, over 90 percent of the region's food production is fed by rain, with the combined impact of droughts, floods, pests and diseases causing catastrophic losses to harvests. The region also has over half Africa's livestock, with nearly 300m cattle, goats and sheep and several million camels and pigs and livestock accounting for around 40 percent of the agricultural GDP of Ethiopia and Kenya and 20 percent of Uganda's.

Up to 80 percent of rural households own livestock. Yet rising temperatures reduce livestock fertility, breeding, milk production, and growth and additionally contribute to rising levels of disease and pests.

In sum, on the frontline of climate change, East Africans in 2023 are losing their food, water, shelter, utilities, livelihoods and health, to global warming.



Climate Change in Ethiopia



Ethiopia is a key water tower for Africa with abundant water supplies across 12 river basins. However, across mountains, lowlands, and encroaching desert, its water resources are unevenly distributed and water scarcity is now emerging as a recurrent challenge, alongside increasingly frequent flash floods.

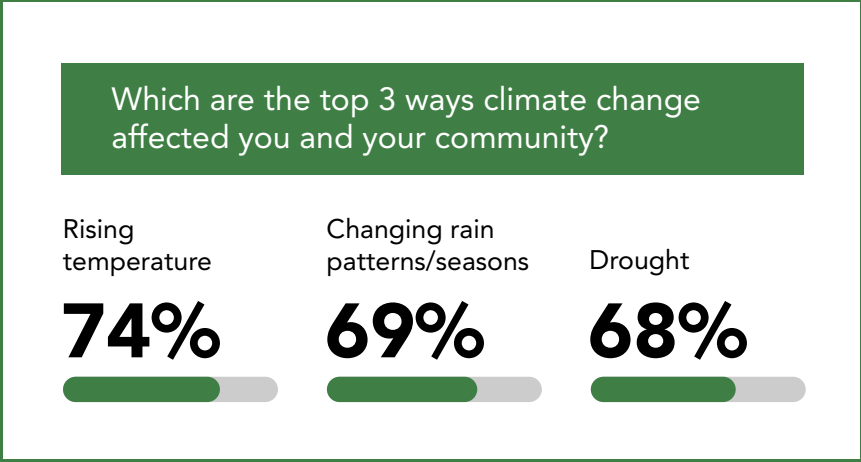


The country's mean annual temperature rose by 1.3° C from 1960 to 2006, and is projected to increase by 1.8° by 2050 and by 3.7° by the end of the century.

The rising heat is reducing soil moisture and general rainfall and causing a decline in the country's total volume of fresh water, despite forecasts of a 20 percent increase in extreme heavy rainfall events by the end of the century. As a result, the volume of water in several Nile tributaries is forecast to fall by 30 percent by 2050, causing a fivefold increase in the proportion of the population suffering from water scarcity, to 30 percent, as well as shortages of water for hydropower and agricultural irrigation.

Figure 4: Climate change impacts reported by 1,000 Ethiopians polled

Source: GeoPoll survey 2023, for Lemelson Foundation



Weather extremes, rising temperatures and declining rainfall are also driving accelerated desertification in the country's eastern regions. More than 85 percent of the land in Ethiopia is now degraded, and 75 percent is affected by desertification. Satellite images show that 23 percent of the country's land area has been degraded in the last three decades, reducing agricultural output, which is the country's mainstay. This has delivered a higher percentage reporting their communities affected by drought, according to the poll results in Figure 4, than the percentage of the population forecast to be affected in East Africa by the Global Center on Climate Adaptation (see Figure 2).

Ethiopia has also suffered heavier than average droughts than other countries in the region.

Estimates suggest that, by 2045, climate change will have reduced the country's GDP by 10 percent, based substantially on the impact on rain-fed **agriculture**, which supports around 85 percent of the population and accounts for over half of GDP. The food insecurity and economic losses are being exacerbated by farmers' dependence on long-cycle crops that require two rainy seasons to reach harvest, the level of livestock deaths - with up to 15 percent of the population supported as pastoralists on two-thirds of the country's land area, and the acceleration in soil erosion.

Climate changes are also increasing pests and diseases, such as maize lethal necrosis, wheat rust and Faba bean leaf and stem gall, while the IFRC reports

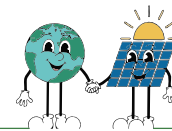
that the country is emerging as a hotspot for zoonotic diseases, such as rabies, anthrax, and brucellosis. **Health** impacts also include the spread of malaria and dengue fever into the highlands, and increased waterborne illnesses, such as diarrhoea, cholera and dysentery. In addition, more than 70,000 deaths a year are being caused by the country's poor air quality, which is being aggravated by the rising heat and now averages twice the WHO health limit indoors and 1.5 times outdoors. Heat stress is also commonplace, with one study finding 74.6 percent of outdoor sugar factory workers in the country had suffered from heat-related illnesses.

Ethiopia's deep droughts are also creating a long tail

of health impacts, with the IFRC pointing to evidence that "children aged five or under are 36 per cent more likely to be undernourished if they are born in a drought season in Ethiopia".

At the same time, the country's infrastructure is being significantly affected. Ethiopia is currently adding roads faster than any other sub-Saharan nation, with over 200,000 km of roads, most of them unpaved. However, the World Bank calculated in 2017 that the damage from climate change-driven flooding, erosion, and landslides will cost up to 35 times as much to repair as the normal repair budget. Meanwhile, hydropower accounts for over 80 percent of its power supply, but is being affected by water shortages.

Hello Solar: Giving electricity access to families in remote communities



<p>The adaptation challenge</p>	<p>Increasingly erratic rainfall, more frequent drought, and the increase of runoff from soils dried at higher temperatures is reducing the availability of water for the hydroelectric plants that provide 90 percent of Ethiopia's electricity.</p>
<p>The enterprise solution</p>	<p>Hello Solar compiles full solar panel kits that include adapted Pay-as-You-Go (PAYG) chips and installs them in remote, rural homes without electricity or reliable electricity supplies. Consumers pay for the equipment in flexible installments over one year. They can pay as regularly as they like, and based on their power needs and budgets. Each installment gives them access to the solar power for an equivalent amount of time at a lower rate than the cost of other energy sources, such as kerosene and candles. Once the installments have covered the full installation cost, consumers are given permanent access and the equipment belongs to them. The payments and code sharing to activate the PAYG periods are made by phone.</p>
<p>Finance and sustainability</p>	<p>Launched by the CEO of the country's leading supplier of digital banking tools, Belcash, Hello Solar began in partnership with Belcash, and has received funding from development finance institutions and donor agencies, including the Shell Foundation, USAID and UKAID.</p> <p>Sustainability was slowed by the challenges of last-mile distribution and servicing, but close attention to phone-based customer services is now reducing the cost of these. Sustainability requires a large critical mass of customers and distributors, prompting its move into a new round of funding in 2023 to drive expansion.</p>
<p>The impact</p>	<p>By July 2023, Hello Solar had impacted an estimated 80,000 lives, installing more than 14,000 solar systems across Ethiopia. It is also providing jobs and livelihoods for local distributors and installers, and in early-stage domestic manufacturing.</p>

Climate Change in Kenya

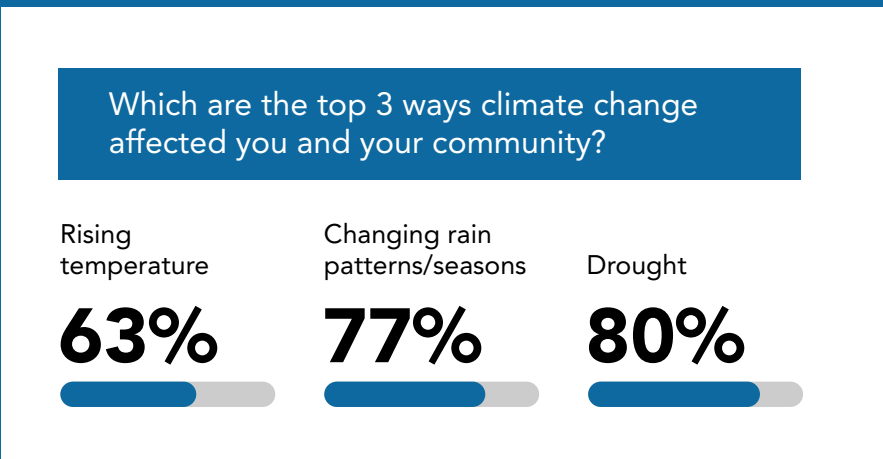


Kenya now experiences flooding that costs around 5.5 percent of GDP on average every seven years and drought that costs around 8 percent of GDP on average every five years. These weather extremes overlay a steady rise in temperatures and decline in water resources.

Like Ethiopia, Kenya has suffered more from droughts than other countries in East Africa, with 80 percent of communities reporting it had impacted them, compared with the Global Center on Climate Adaptation that 39 percent of the East African population would be affected by drought on a 2 degree temperature rise.



Figure 5: Climate change impacts reported by 2,000 Kenyans polled



Source: GeoPoll survey 2023, for Lemelson Foundation

In 2017, an analysis of meteorological data for Kakamega and Siaya counties found temperatures had risen by around 2°C since 1901, while the World Bank shows the country’s average temperatures from 1991 to 2020 were 1.5° higher than from 1901 to 1930. Kenya’s temperatures are forecast to rise by a further 1.5C° to 2.5C° by 2050, making for a total rise of up to 4°, which will threaten the existence of human life across much of the country.

At the same time, water supplies continue to be depleted. Rainfall has declined due to El-Nina changes and ecosystem degradation, water retention has diminished, and sea levels are rising, with sea water intrusion identified in ground water along the breadth

of the coast, causing the salinisation of land-based water supplies.

In 2020, the government estimated the total socio-economic cost of climate changes at 3 to 4 percent of GDP a year, representing an increase of some 30 percent on its impact estimates of three years earlier. The costs are now certain to be higher still, with subsequent locust invasions, a current severe drought, and record temperatures destroying crops and livestock. Agriculture accounts for around 33 percent of GDP, but around 98% of crops grown in Kenya are rainfed. The country’s short rains no longer routinely support a harvest or livestock, while its long rains have shortened from nearly 60 days to 30.

Stable Foods: Building low-cost irrigation-as-a-service for smallholder farmers



<p>The adaptation challenge</p>	<p>Increased rainfall disruption, the breakdown of normal rain patterns, at the same time as greater drought, soil drying and runoff are increasing crop vulnerability to rainfall gaps, and hampering planning and investment.</p>
<p>The enterprise solution</p>	<p>Stable Foods has launched collective irrigation systems in western Kenya, developing boreholes and installing pumps and distribution piping to subscribers who access the irrigation as a service on a pay-as-you-go metering system. The subscribers are also provided with agricultural extension and market linkages.</p>
<p>Finance and sustainability</p>	<p>The business was founded by a group of entrepreneurs in partnership with venture studio Pyramidid Ventures, and has been built with seed investment from Acumen Resilient Agriculture Fund (AFAF) and Mercy Corps Ventures. The subscribed irrigation infrastructure has demonstrated sustainability in western Kenya and Stable Foods is now seeking new investments to provide the CapEx for expansion.</p>
<p>The impact</p>	<p>Increases yields by 5-8 times, provides irrigation that is affordable for 90 percent of smallholder farmers compared with 4 percent who can afford the current solutions, and secures an estimated 8-fold increase in earnings for subscribing farmers by allowing them to move to three harvests a year, supported by training in growing irrigated off-season crops that earn higher prices, and making sales via Stable Foods’ food stores.</p>

The country has also suffered new waves of pests, such as the Golden Apple Snail, now destroying the country's formerly successful rice plantations, alongside mounting water shortages. As a result of these latest developments, over 5.4 million Kenyans and 32 percent of those living in the country's arid and semi-arid lands are now suffering acute food insecurity.

Health is also deteriorating. Many areas in the country's cities now top WHO safety levels for air particulates. Increased pests and heat are accelerating the spread of diseases such as Dengue and West Nile fever, cholera and malaria, with disease-carrying mosquitoes breeding at greater speed and spreading to areas previously too cool for their survival. Heat deaths that affect children and the elderly at temperatures over 35 degrees are also rising, with John Hopkins University finding indoor temperatures regularly topping 40 degrees in Nairobi's slums, at levels up to 4 degrees higher than areas half a mile away, due to the absence of trees and vegetation, the building materials used, and a lack of ventilation. As water scarcity grows, less than half the rural population and 85% of the urban population has access to safe water.

Heat and weather extremes are also undermining **infrastructure**, which currently draws about a third of government spending, with the cost of climate-induced repairs to paved and unpaved roads, alone, expected to be more than four times greater than the historic costs, according to the World Bank.

Over two-thirds of 2,000 Kenyans polled for this reported they had experienced cut-offs in food and water due to climate-induced infrastructure damage. At the same time, increasing water scarcity is reducing the country's energy supplies, with around 30% of Kenya's electricity produced as hydropower.

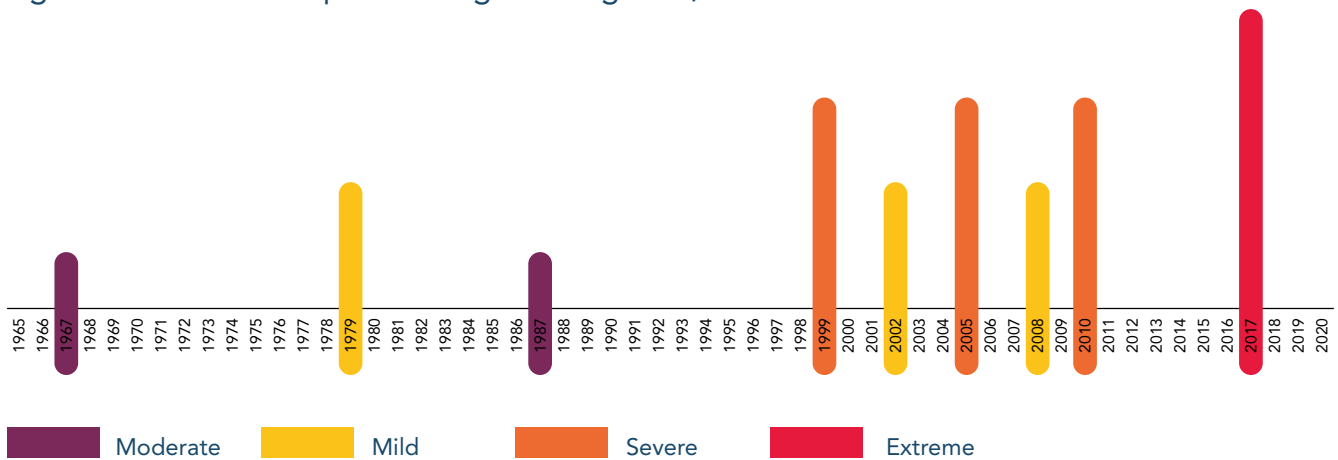


Climate Change in Uganda



Landlocked Uganda, made up of mountains, lowlands and a cattle corridor, is suffering nationwide temperature rises. In the north, where livestock production is concentrated, increased rainfall, but diminished water capture and more frequent droughts, are leading to accelerated desertification, while, in the south, declining rainfall is hitting the country's rain-fed crops. The eastern lowlands, both north and south, are additionally experiencing regular and catastrophic flooding.

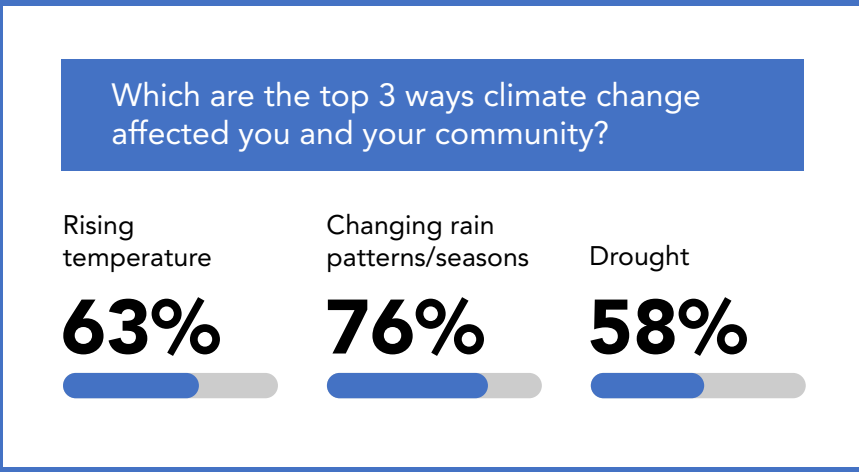
Figure 6: Timeline Graphic. Droughts in Uganda, 1967 to 2017



Source: [World Bank, 2019](#)

Over the 30 years to 2018, Uganda's average temperature rose by 0.52 C per decade and is expected to have risen by more than 2 degrees by 2030, and by up to 4.2 degrees by 2100. At the same time, rainfall has become irregular and unpredictable, with more rain falling in the dry season, while the normal rainy seasons are often failing or truncated, despite forecasts of an overall increase in rainfall of up to 22 percent. With water capture and soil moisture declining in the greater heat, the increasingly erratic rainfall has also led to a surge in flash floods on cyclones, causing high death tolls and homelessness. By 2015, floods were, each year, affecting nearly 50,000 people and costing over \$62 million. At the same time, 4.5 million people, or around 10 percent of the population, are now affected by water scarcity.

Figure 7: Climate change impacts reported by 2,000 Ugandans polled



Source: GeoPoll survey 2023, for Lemelson Foundation

Spouts of Water:

Retooling ancient ceramic technologies to clean water



<p>The adaptation challenge</p>	<p>Climate change is driving water scarcity and reducing water quality, while rising temperatures make air pollution more toxic.</p>
<p>The enterprise solution</p>	<p>Spouts of Water is a US-based non-profit with business operations in Uganda since 2015. The Ugandan business provides ceramic water filters made in Uganda with sawdust that creates micropores, preventing the passage of dirt and bacteria and enhanced by an additional layer of silver nitrate. The business also provides clean energy stoves for homes.</p>
<p>Finance and sustainability</p>	<p>The social enterprise is partnered by Open Capital Advisers and CQuest Capital and has received funding from development organisations, such as Save the Children and Viva con Agua. Its filters are priced at a level that is cheaper than boiling water and are sold directly to consumers, principally through wholesalers and supermarkets. It also provides donor-funded filters and stoves to refugee camps and other social programmes, as well as to government agencies, such as the prison service.</p>
<p>The Impact</p>	<p>The social enterprise is partnered by Open Capital Advisers and CQuest Capital and has received funding from development organisations, such as Save the Children and Viva con Agua. Its filters are priced at a level that is cheaper than boiling water and are sold directly to consumers, principally through wholesalers and supermarkets. It also provides donor-funded filters and stoves to refugee camps and other social programmes, as well as to government agencies, such as the prison service.</p>

The Climate and Development Knowledge Network (CDKN) estimated in 2015 that climate change damage to agriculture, water, infrastructure and energy, alone, would be costing the country \$3.2bn to \$5.9 billion a year by 2025 and around 2.4 per cent of GDP. It also mapped how costs would rise if no adaptation measures were introduced, forecasting they would grow by a multiple of 24.46 times to \$273bn to \$437bn from 2010 to 2050.

Agriculture accounts for 25 percent of Uganda’s GDP and supports 70 percent of the labour force. Yet, by 2015, a survey of nearly 8,000 farmers in south-western Uganda found 87.8 percent had suffered major crop losses in the previous year from drought, 20.6 percent from flooding, and 39.1 percent from pests and diseases, while Uganda’s 2018 agricultural census found that of 2 million food-insecure households, 91.5 percent had been

affected by drought, and 66 percent by pests and diseases (BMAU, 2018).

The impact of climate change on human health has also been extreme. Heavier rains and frequent flooding are increasing the incidence of all water-borne disease, including dysentery, hepatitis E, and cholera, with an increasing frequency of epidemics such as the 1998 cholera outbreak that hospitalised 11,000 people, as floods and landslides caused by the same inundation displaced 150,000. The 1998 cholera outbreak cost \$4.3m to control and killed 1,682 people and has been followed by repeated and more frequent outbreaks. The rising heat has also driven up malaria, with the costs of combating malaria forecast to more than double by 2050, from 2010 levels. Malnutrition-related diseases and respiratory diseases are also surging.

Kampala is one of the world's most polluted cities, with air pollution running at up to seven times WHO safe standards, killing an estimated 28,000 people a year. City dwellers are also suffering increasingly from heat stress, with a 2022 study reporting a combined humidity and temperature measure at over 40 degrees on 68 percent of tested days in the city's slum areas. **Infrastructure** is, likewise, experiencing rising climate

pressure, most notably through water, and thus energy, supplies, and through the impact of extreme heat and floods on the road network. Road transport accounts for 90 percent of the country's passenger and freight traffic. Yet the World Bank forecasts Uganda will need to spend 20 times its historical road building on repairs to its existing road network from climate change damage.





Investment
Opportunities for
Climate Investors



Chapter Three:

Investment Opportunities for Climate Investors



Priming private sector investment in climate adaptation innovations In East Africa

Private sector finance is critical to securing climate adaptation in East Africa. But for innovator entrepreneurs to play a role in achieving adaptation, they must develop and /or propagate a technology that reduces a key climate impact;

In this, there are some climate impacts that already offer large and immediate scope for entrepreneurs to deliver climate relief, while in other areas their role looks set to be more limited or delayed.

For this reason, we reviewed each climate change impact in the report’s focus sectors of agriculture, infrastructure and health to establish the scale and nature of its business potential.

A key measure was the likely scale of impact. For instance, for water creation, we established that one-in-five East Africans currently lacks access to safe water, with unsafe water causing almost 100,000 deaths a year in our focus countries as long ago as 2016. In other areas, such as heat stress, the mortalities are often assigned to other causes, such as heart attacks, asthma, or kidney disease, all of which are exacerbated by extreme heat. This leads to pervasive undercounting. But such deaths have also been concentrated in urban areas, and most typically in the slums, making for a lesser total impact than water scarcity.

The reality is that all of the impacts that we have assessed are leading to mortalities, but some are killing a far greater number of East Africans than others.

In each area, we then looked at the technologies emerging to reduce these deaths: were there abundant new options, or only a single new contender? We also looked at the stage of development of technologies, with some still at the research and development stage while others had already been launched to market.

Finally, we needed to consider the business model, which spanned several elements, but which represents a critical bridge in moving climate adaptation into mainstream business. Many projects are working with communities to build their resilience, but formulating social enterprises that can deliver material benefits to citizens who are often in the lowest income brackets, while generating sustainable business revenue, is a challenge of its own.

A frequent problem in this area is lack of ownership, with the value chains from technology to beneficiaries sometimes impossible to control, and thus monetise. For instance, water towers that purify air, for example, cannot control the consumption of the cleaner air. Likewise, who will pay as a consumer for the release of adapted mosquitoes to bring down the general mosquito population?

Such public benefits are likely to depend on the government as the payer, which can add considerable roadblocks to their adoption, requiring changes such as the amendment of standards to incorporate novel solutions (see case study), or the adaptation of public policies, priorities, and spending plans. Enabling the engagement of entrepreneurs in delivering technologies as public goods may require cross-cutting innovation teams in government agencies and the development of fast-track pathways.

Even where a technology exists that can be monetised, it may face specific obstacles to commercialisation. These can include regulatory constraints or public sector policies. For instance, in road technology, climate solutions can reduce long-term public outlay, but they represent greater near-term spending - motivated by later savings and greater public service delivery ahead - that must be authorised as an additional outlay. That requires the development of public sector strategies, policies and plans, which can be a process that takes many years. New road technologies may also require the adaptation of building codes.



Steam Plant invests in long-term public policy reformulation to open cooling market



<p>The adaptation challenge</p>	<p>Temperatures have risen most extremely in low-income urban areas without trees or shade and with absorbent tin roofs, causing dangerous heat inside homes and buildings that is delivering an estimated 20 percent increase in young and elderly mortality at its peaks.</p>
<p>The enterprise solution</p>	<p>Steam Plant is a 32-year-old Nairobi-based engineering business that has evolved from supplying steam systems and instrumentation into daylighting and passive cooling technologies. It provides highly reflective cooling paints for industrial roofs, and, in 2019, won grant funding to cool-paint informal settlement roofs. It has since engaged with government to add passive cooling into the building code and the National Cooling Action Plan, and is working to develop public-private partnerships to fund cool painting in slum areas. The kind of long-term public policy reform needed to drive new public spending commitments has proven too slow for many start-ups, but this established, innovative business has self-funded its engagements to secure long-term reform.</p>
<p>Finance and sustainability</p>	<p>Steam Plant was awarded a \$100,000 grant in the global Million Cool Roofs Challenge, which saw it expand from its business base as a technology supplier to industry into the cool painting of homes, schools, hospitals and community buildings, particularly in low-income areas, demonstrating the potentially transformative power of intentionally catalytic grants. The business is still working to secure a viable business model for these markets.</p>
<p>The Impact</p>	<p>Steam Plant trained and employed youth in Nairobi's informal settlement, who painted 11,000m² of roofs, lowering building temperatures, but also reducing 'heat islands', which lowered temperatures in the surrounding areas too.</p>

For low-margin innovations, that rest on uptake by a million smallholders, ramping up production, distribution networks and buyer awareness can cost sums that low-cost solutions may never recoup.

On this basis, the business model is likely to define the viability of businesses for entrepreneurs: can they achieve sustainable businesses in this area, or even highly profitable ones?

Having assessed these factors, we classified climate impact sectors into:

01

The top opportunities, with the most emerging technologies, clearest business models and prospects of sustainability, and highest impact;

02

Spaces to watch, where new technologies are pre-market, the climate impact is somewhat smaller but growing, or business models are not yet established;

03

Steady growers, where new technologies are already on the market, being delivered by sustainable businesses, but with plenty of scope for expansion; and

04

Not impossible: where the impact would be very high, but there are barriers to entrepreneurial innovation and entry.

In selecting the examples of emerging or existing technologies in the area, we scanned for all potential East African innovations, but also included innovations from elsewhere in the world that offered potential in the East African context.



Heat One: Top Opportunities

Water production
 Soil enhancement
 Pollution removal
 Safe sanitation

Water production

People impacted:

Deaths from unsafe water, unsafe sanitation and lack of hygiene in 2016:

Measure of water scarcity

One in five people in East Africa – **33.5 million** people across Ethiopia, Kenya and Somalia – don't have enough safe drinking water.

Kenya: 27,141
Uganda: 14,488
Ethiopia: 52,571

Development stage

R&D	Engineering	Early Market	Mature
X	X		

Commercial viability

Feasible	Complex	Challenging	
X			

Income potential

Unprofitable	Low profit	Sustainable	High profits
	X	X	

Water-borne diseases spread rapidly in floods, which empty pit latrines into waterways and sources. Water scarcity also increases the spread of disease, since it can force people to drink from water sources that are unfit. However, there are a range of water harvesting and purification technologies now emerging:

- Water filters using moringa tree extracts and aluminium sulphates to clean water
- Re-engineering of traditional ceramic filters to achieve safe water¹, see Uganda
- The use of negatively charged molecules to disinfect water in rural water filters and solar filtration systems, see Uganda
- Use of singlet oxygen for disinfecting drinking water
- Water purification using membranes, ultraviolet light and electrolysis
- LifeStraw hollow membrane technology
- Solar-powered desalination plants can clean wastewater, provide potable water, or sterilise medical tools in off-grid areas
- Zero Mass Water – hydro panels creating drinking water from sunlight and air
- Carbon credits for water purification, which prevents water boiling, implemented in public and private partnerships and attracting some private sector entrants
- Solar-powered irrigation systems
- Fog collectors, such as the Warka Water tower developed in Ethiopia, harvest water from fog, humidity, dew and rain to produce 100 litres of water a day.



Warka Water Tower, developed in Ethiopia to capture water from the air

Water purification offers multiple pathways for innovator entrepreneurs. The Ethiopian government is investing in large-scale desalination, with small-scale desalination also on the drawing board. In Kenya, the water sector has a strong precedent for private water companies, although new water technologies are nascent as social enterprises. But in Uganda businesses such as Spouts of Water and Vepox are strong starters.

Soil enhancement

People impacted:

Eroded soil fertility erodes maize yields by

14% to 39%

Development stage

R&D	Engineering	Early Market	Mature
X	X	X	

Commercial viability

Feasible	Complex	Challenging	
X			

Income potential

Unprofitable	Low profit	Sustainable	High profits
		X	X

Raised temperatures and wind erosion increase evaporation from soil and deplete groundwater leaving soils dry and unable to absorb new water well. This leads to increased run-off and flooding. The dryness makes soils less fertile, which can significantly reduce crop yields and food security.

Soil moisture technology has been highlighted by the United Nations' Compact as a globally transformative sector that is moving into rapid take-off.

New technologies include:

- Nanoclays and hydrogels can improve soil water retention by more than 10%
- Subsurface Water Retention Technology is a sub-surface barrier to slow the loss of water
- Low-tech plant cocoons such as Waterboxx, cut water use by up to 90%
- Water-holding gels and polymers adhere to seeds and encourage water retention
- Soil moisture sensors are being developed from space and for low-cost ground use
- Short-term Biochar application shows improved soil moisture retention after irrigation by 19% in the first year and 25% in the second year
- Sensors, drones, and smart irrigation to remotely monitor humidity, temperature, pH, moisture and nutrients. Ground sensors can be combined with aerial technologies to reinforce data

This rise of this sector is being driven by innovator entrepreneurs globally as well as in East Africa. The 2017 UN Global Opportunity Report identified Sub-Saharan Africa as one of the regions likely to benefit most from the technology and the most likely to embrace it widely.

Pollution removal

Impact:



Development stage

R&D	Engineering	Early Market	Mature
X	X	X	X

Commercial viability

Feasible	Complex	Challenging	
X	X		

Income potential

Unprofitable	Low profit	Sustainable	High profits
X	X	X	

As air temperature rises globally, particulate pollution increases, worsening the health risks. Researchers and local innovators are exploring options to lower the health risks and decrease indoor and outdoor air pollution:

- Car filters: charcoal air filters can reduce levels of nitrogen dioxide inside the car by as much as 90%
- Electric vehicles, projected to expand in the coming decade; some companies are supporting the transition
- Incinerator filters which reduce emissions when burning waste
- Incinerators which convert waste to energy
- Genetically modified plants that absorb elevated levels of CO2 and pollutants in the home
- Plants that absorb roadside pollution such as cotoneaster and genetically modified poplars
- Photo-catalytic treatments applied to roads, roofs and walks, which remove pollutants from the air in the presence of sunlight
- Air purifying towers which extract pollution and expel clean air
- Devices on vehicle exhausts turning pollution into ink
- Moss grown vertically to absorb pollutants
- Fuel efficient cooking stoves

Air cleansing offers an array of routes to market for innovator entrepreneurs. Business models are likely to require careful development, but there is scope for product adoption. The model of earning carbon credits for the low-price sale of cooking stoves that prevent indoor air pollution adds likely traction, if the carbon market redevelops.

Circular sanitation

People impacted:

Pit latrines are used by more than half the urban population in Sub-Saharan Africa

Percentage of open defecation in Sub-Saharan Africa:

22.5%

Development stage

R&D	Engineering	Early Market	Mature
X	X	X	

Commercial viability

Feasible	Complex	Challenging	Very challenging
X			

Income potential

Unprofitable	Low profit	Sustainable	High profits
		X	X

Poor sanitation, flooding that carries waste into waterways, and water scarcity are all increasing disease levels. Innovators are developing a wide range of solutions, most of which develop the 'circular economy' using the waste to make products such as fertiliser and animal feed:

- Stand-alone toilet blocks as part of recycling, for instance by emptying their waste pods (see case study)
- Modular precast toilets that convert sludge into cooking briquettes
- Waterless flush toilets that convert faeces into fertiliser
- Polymer film for waterless flush system
- PeePeople – a biodegradable bag that sanitises human faeces and turns it into fertiliser in around a month
- Wastewater treatment plants in a box which treats faeces to be composted or disposed of, and recycles the water



Heat Two: Spaces to Watch

Heat stress
 Vector reduction
 Crop cooling
 Resilient roads

Heat stress

People impacted:

In 2015, an estimated
44% of Kenyans
and 25% of Ugandans
 had tin roofs and improved housing materials

Development stage

R&D	Engineering	Early Market	Mature
X	X	X	

Commercial viability

Feasible	Complex	Challenging	Very challenging
X	X		

Income potential

Unprofitable	Low profit	Sustainable	High profits
X	X		X

Temperature increases are greatest in urban and slum areas, where building materials such as tin roofs speed up heating, but air conditioning units are out of reach financially. High humidity is also increasing cases of heat stress with moisture in the air preventing sweat from evaporating, which is essential to the body's ability to cool itself down. Innovations include:

- Cool roofs: paints and tiles reflecting the sun from roofs, which can decrease internal temperatures by 3°C to 83°C
- Air coolers built with terracotta tubes in a bed of water
- Composite film to accelerate evaporation of sweat in PPE, protecting workers
- Patches that monitor dehydration and can be tracked with a smartphone
- Building materials and designs are developed to provide better reflection, insulation, and ventilation and designs to use shade
- Bioclimatic design for reduction of a building's energy consumption and improvement in living space
- Solar powered cooling systems
- Composites added to cow dung walls of clay and water-soluble polymers dry out air and reduce humidity.

There are many challenges to achieving a revenue model for heat protection in slums, but the proportion of tin roofs is likely to be high in any of the target markets. The need for business innovation is great, but sustainability will be a challenge without innovative revenue models.

Vector reduction - curbing malaria

Impact:



Development stage

R&D	Engineering	Early Market	Mature
X	X	X	

Commercial viability

Feasible	Complex	Challenging	Very challenging
X	X		

Income potential

Unprofitable	Low profit	Sustainable	High profits
		X	X

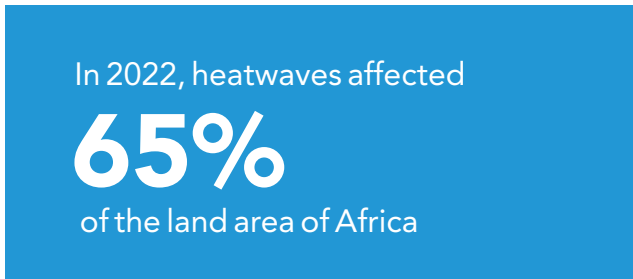
Higher temperatures are shortening the breeding time for insects such as mosquitoes, as they develop resistance to insecticides and spread to highland areas that were previously too cold for them, taking with them malaria, dengue fever, chikungunya and other diseases and parasites. This has intensified efforts to find new controls that include:

- Traps emitting carbon dioxide that mimic human breathing
- Sugar ball traps
- Irradiated infertile mosquitoes, designed to close down breeding lines
- Wolbachia-infected mosquitoes, can no longer transmit key human diseases
- Genetically modified mosquitoes, including modifications adding a gene to male mosquitoes preventing female offspring from surviving, thereby ending the breeding line, and others that modify mosquitoes so that malaria parasites cannot develop in their systems, which prevents them passing them on.

The modification of mosquito genetics and populations is being pursued by large research institutions and donors, but new trap technologies tend to be private innovations and businesses that offer the potential for sustainable businesses.

Crop cooling

People impacted:



Development stage

R&D	Engineering	Early Market	Mature
X	X	X	X

Commercial viability

Feasible	Complex	Challenging	Very challenging
X			

Income potential

Unprofitable	Low profit	Sustainable	High profits
		X	

High temperatures can prevent fruit crops from growing flowers and fruits, and can damage cereal and other staple crops, in some cases reducing yields to zero. Reducing plants' temperature conserves precious water resources and increases photosynthesis and yields.

Innovations to encourage crop cooling:

- Kaolin, a reflective clay that is now being sprayed in plants, particularly fruit trees, to reflect radiated heat
- Shade cloths, which are being tested in bright colours to identify which most cool the crops underneath
- Particle films developed for pest control are also reducing ultraviolet damage and fruit burn
- Fogging and misting systems, cool crops with fine water sprays that are now being developed in smaller droplets
- Root cooling in hydroponic floating
- Moringa leaf extract sprays, which can increase drought resistance, efficiency of water use, and yields

Crop cooling is not generally a field dominated by existing large brands. Opportunities for innovation provide space for scalable businesses and the possibility of strong profitability.

Resilient roads

People impacted:



Development stage

R&D	Engineering	Early Market	Mature
	X	X	X

Commercial viability

Feasible	Complex	Challenging	Very challenging
X	X		

Income potential

Unprofitable	Low profit	Sustainable	High profits
	X	X	

Road networks in East Africa are prone to degradation and damage by extreme weather. In Kenya, 46% of road surfaces are earth roads, which are at particular risk of damage by heavy rainfall and floods. Ethiopia has the second largest population in Africa and an expanding road network of 144,000 km; it is also among the countries most vulnerable to natural hazards such as flooding, erosion, and landslides. Poor road quality and damaged road networks are a significant cause of road traffic injuries and fatalities and are also critical in supplying rural areas and connecting to markets. Technology emerging:

- Polymer or plastic roads – recycles waste plastics as a mix with asphalt, making crack-proof surfaces
- Improvements to drainage infrastructure to mitigate effects of flooding on roads
- Case by case flood protection measures, which are generally low-tech – particularly in coastal areas (applicable to Kenya and Ethiopia)

This area is likely to support a set of construction-oriented innovators, where solutions can be developed.

Heat Three: Steady Growers

Soil replacement
 Water use
 Local energy

Soil replacement: Hydroponics

Impact:

An estimated

65%

of agricultural land is degraded across Africa.

People impacted:

1M	10M	100M	1BN
		X	

Development stage

R&D	Engineering	Early Market	Mature
X	X	X	X

Commercial viability

Feasible	Complex	Challenging	Very challenging
	X		

Income potential

Unprofitable	Low profit	Sustainable	High profits
			X

Hydroponic farming grows plants in nutrient-filled water instead of soil, which requires fewer pesticides and grows crops up to 100 percent faster, uses up to 90 percent less water and 75 percent less space. Cheaper hydroponics systems are already taking off where space is constrained, in refugee camps and near crowded cities.

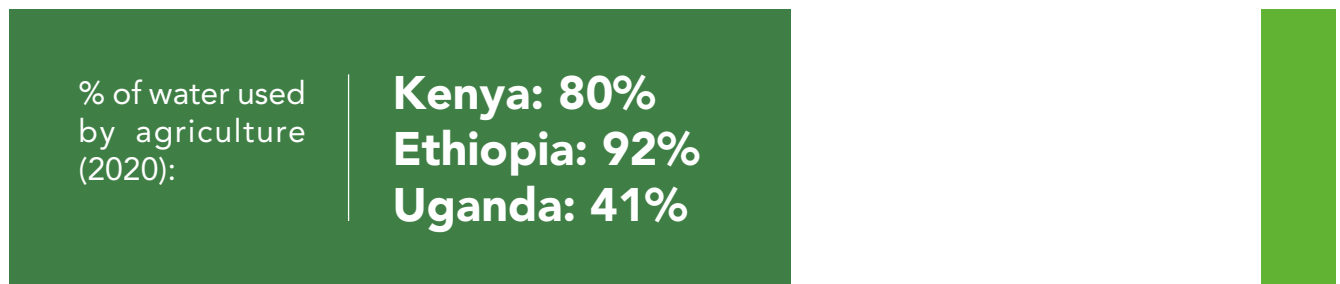
Innovations for hydroponic systems:

- Deep water culture hydroponics (DWC), in which a plants' roots are suspended in an aerated water and nutrient solution, is the most common and cheapest technology
- Wick system: crops are settled in a nutrient-infused fabric string in water
- Nutrient film technique (NFT) systems, in which plants are suspended above a continuously flowing solution containing nutrients
- Drip system: pumps a nutrient-rich solution through a tube network to plants
- Ebb and flow hydroponics: floods a grow bed with a nutrient solution from a reservoir below
- Aeroponics: plants hang in an enclosed space with naked roots exposed to a nutrient-filled mist – this technique differs from hydroponics

The hydroponics industry has been increasingly invested in, and saw upwards of \$500 million in investments in 2020. While much of this investment is going to companies in high income countries, investments in Africa are predicted to increase by 11.3 percent in the next 5 years.

Water use

Impact:



Development stage

R&D	Engineering	Early Market	Mature
X	X	X	X

Commercial viability

Feasible	Complex	Challenging	Very challenging
X	X		

Income potential

Unprofitable	Low profit	Sustainable	High profits
			X

Globally, 70 percent of all freshwater is used for agriculture. With the world's population set to reach 9 billion by 2050, water use in agriculture is also set to increase creating increased vulnerability to water scarcity. While irrigated agriculture is generally more productive than rainfed agriculture, up to 95 percent of cultivated land in sub-saharan Africa is rainfed.

Innovations to improve water efficiency in agriculture are all currently at the development stage:

- Low cost sensor-free irrigation is being rolled out in Kenya to align irrigation with crops' precise irrigation needs
- Smart drip irrigation systems monitor and control crop conditions and can be monitored via apps
- Infrared thermal imagery monitors water stress in crops
- Automated soil moisture-based basin irrigation systems employ wireless communication and has improved irrigation efficiency

There are strong opportunities for regional entrepreneurs to develop low-cost alternatives to high-tech precision irrigation, with low-cost sensor-free irrigation that reduces over-watering emerging as a strong market. CGIAR reports returns on investment on small-scale irrigation of 17 to 32 percent, with potential benefit to nearly 400 million people in subSaharan Africa, generating \$20bn in additional income.

Local energy

Impact:

East Africa suffers an average of
30.38 hours
of power outages a month
(2017)

75.4%
of East African businesses
suffer power outages, causing
losses to annual sales of **5.8%**
(2017)

Development stage

R&D	Engineering	Early Market	Mature
X	X	X	X

Commercial viability

Feasible	Complex	Challenging	Very challenging
X	X		

Income potential

Unprofitable	Low profit	Sustainable	High profits
X	X	X	

Hydropower is a leading source of main-grid power across Uganda, Kenya and Ethiopia. But water scarcity is causing regular outages, increasing the need for local energy solutions, such as:

- kW scale wind turbine integrated into a solar powered mini grid (partly locally produced)
- Small scale hydropower systems
- Small wind turbines which could be installed individually in residences and businesses – rotor size 15m in diameter
- Off-grid solar power systems which could be installed in homes and businesses – also reducing air pollution from kerosene lamps etc.
- PULSE (productive use leveraging solar energy) appliances, i.e. solar water pumps
- Waste to energy plant in planning stages in Uganda
- Floating solar power plants connected to hydroelectric power plants to mitigate power outages (proposed in Uganda)

Both Ethiopia and Kenya have ambitious renewables targets, but rather different market setups. In Ethiopia, the government dominates the development of power options, whereas in Kenya, small scale projects and micro-grid systems are much more common, making for different levels of opportunity for entrepreneurs in the different markets.

Heat Four: Not Impossible

Adapted seeds
 Pest control
 Adapted livestock

People impacted:

% of severe
 food insecurity
 (2020):

Kenya: 26.1%
Uganda: 23.2%
Ethiopia: 19.6%

Adapted seeds

Many staple crops in Africa will struggle to survive as temperatures rise, with crop yields projected to fall by up to 20 percent on 2°C of warming. Farmers are already adapting, creating a growing market for climate-resilient seeds. Studies report that drought and heat-resistant seeds could increase yields by up to 25 percent in Africa as the climate changes. But the costs of bulking and marketing can be prohibitive, with the set up of seed breeding pipelines and distribution networks and securing farmer uptake currently taking around 30 years for new crops in Africa. This has seen the space dominated by private foreign companies. The most significant scaleable space for innovators is likely to be in technologies that accelerate the breeding process for the development of crops that are fine-tuned to local needs and niche crops.

Adapted livestock

Half of Africa's livestock is in East Africa and under threat, Livestock adaptation is traditionally a local-level activity, with new technologies, such as gene editing and selection now opening new pathways. But the current disjuncture between high science and traditional cross-breeding sees this area progressing in patches. Areas for further focus include new feeds that confer drought resistance, such as cactus pears, and the animal equivalent to applied cooling and drought technologies.

Pest control

Pests are estimated to cause the loss of 20% to 40% of global crop production, fuelling a pesticide industry worth nearly \$84.5 billion in 2019. But rising temperatures are increasing agricultural pests and diseases exponentially, with some studies finding pests going from one generation a year to more than 20, exactly as resistance grows to traditional pesticides. The sector is seeing hundreds of new solutions a year, from the multinationals that dominate this space and from an expanding biopesticide industry. But for entrepreneurs, it presents the same challenges of distribution and uptake as seed adaptation. For Africa, it would do well to emerge from the foe-versus-foe damage of synthetics versus naturals and move to a next generation of novel and holistic answers to equip the continent to engineer food for humans versus food for insects, viruses and bacterial destruction.



The Climate
Investment
Agenda



Chapter Four:

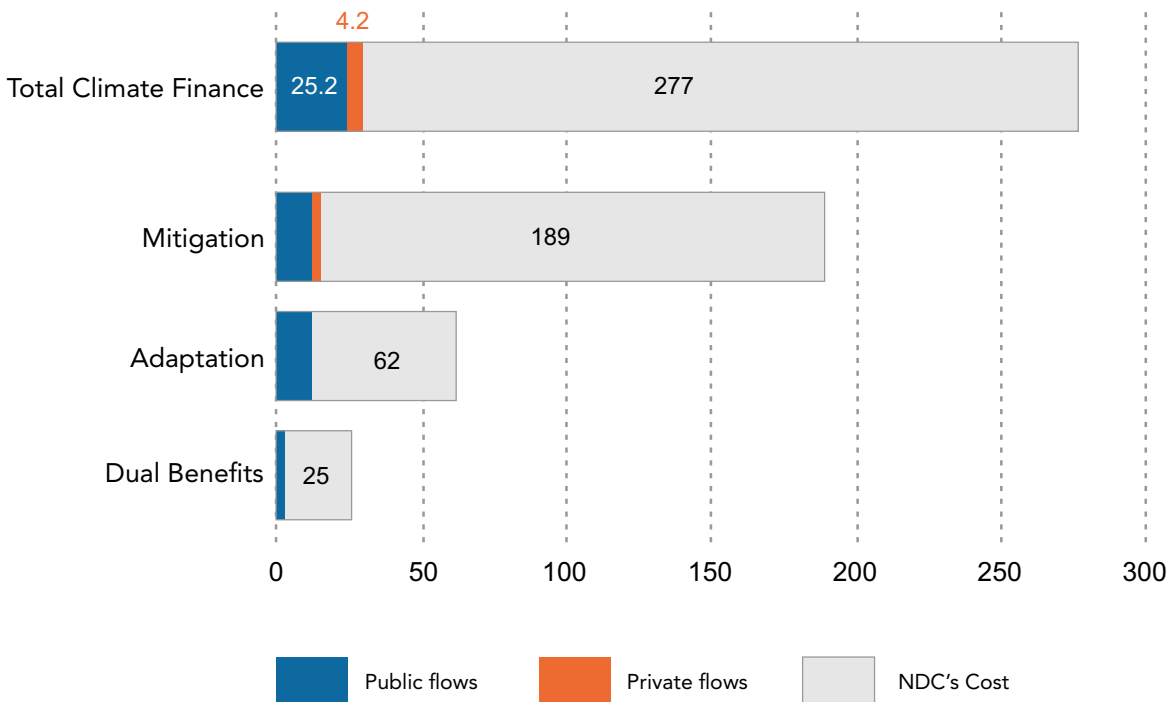
The Climate Investment Agenda



Priming private
sector investment
in climate adaptation
innovations In East Africa

Despite the scale of need and the array of technological opportunities, private investment into East African climate change ventures remains minimal. This represents a crippling and dangerous gap when the financing vision for the continent was built upon a ‘billions-for-trillions’ agenda, premised on private sector engagement. This made it possible to set goals beyond the reach of either international or national donors on the basis that the public sector injections would act as catalysts for a far larger inflow of private investment.

Figure 8. African climate finance flows



Source: Landscape of Climate Finance in Africa, Climate Policy Initiative, 2022

In reality, trillions remain very distant. Data on climate investment flows into Africa is fraught, with few countries tagging climate-related budget items and limited tracking of private sector flows. But Climate Policy Initiative has reported that in 2018, public and private investment in climate-related activities in Kenya totalled \$2.4bn, while the following year, in 2019/2020 total climate funds invested in Ethiopia summed \$1.7bn. The flows into Uganda have been far smaller, with the government reporting \$447.4m of climate finance inflows in 2021/22 as its best estimate. However, while Kenya and Ethiopia have been widely mapped as having relatively large climate inflows, Uganda has only recently directed attention towards climate finance.

Yet, the part played by the private sector in these sums appears to be small. The CPI reports that private investment flows accounted for just 8 percent of Ethiopia’s tracked climate finance in 2019/2020, representing 0.56 percent of the country’s climate finance needs. In Kenya, the private sector accounted

for 40.7 percent of total flows, and 4 percent of climate needs.

A key constraint has been the perceptions of risk in Africa. The Center for Global Development highlights that investors typically take a negative view on investment in the continent on the grounds of “an unstable political context, a volatile macroeconomic situation, or weak institutional and regulatory frameworks”. However, there is a disjuncture between these negative perceptions and the levels of risk as understood by independent researchers.

In 2022, the CPI classified the climate investments in Kenya and Uganda as substantially low risk, with the exception of currency exposure, although Ethiopia’s political context represented a higher risk, with investment funds raising finance during 2020 and 2021, additionally reporting in interviews that commitments were cancelled on the country’s increased instability.

Figure 9: Climate investment risk in Ethiopia, Kenya and Uganda



Table: Country barrier assessment

		Barriers related to enabling skills and infrastructure		
Country	ISO	Lack of data	Lack of infrastructure	Limited technical capacity
Ethiopia	ETH	⬆️	⊖	⬆️
Kenya	KEN	✅	✅	⬇️
Uganda	UGA	⬇️	⊖	⊖

		Financial	
Country	ISO	Currency risk	Access to credit
Ethiopia	ETH	⬆️	⊖
Kenya	KEN	⬆️	⊖
Uganda	UGA	⊖	⊖

		Governance		
Country	ISO	Administrative risk	Political risk	Regulatory risk
Ethiopia	ETH	⊖	⊖	⊖
Kenya	KEN	⊖	⊖	⬇️
Uganda	UGA	⊖	⊖	⬇️

Source: [Climate Policy Initiative](#)

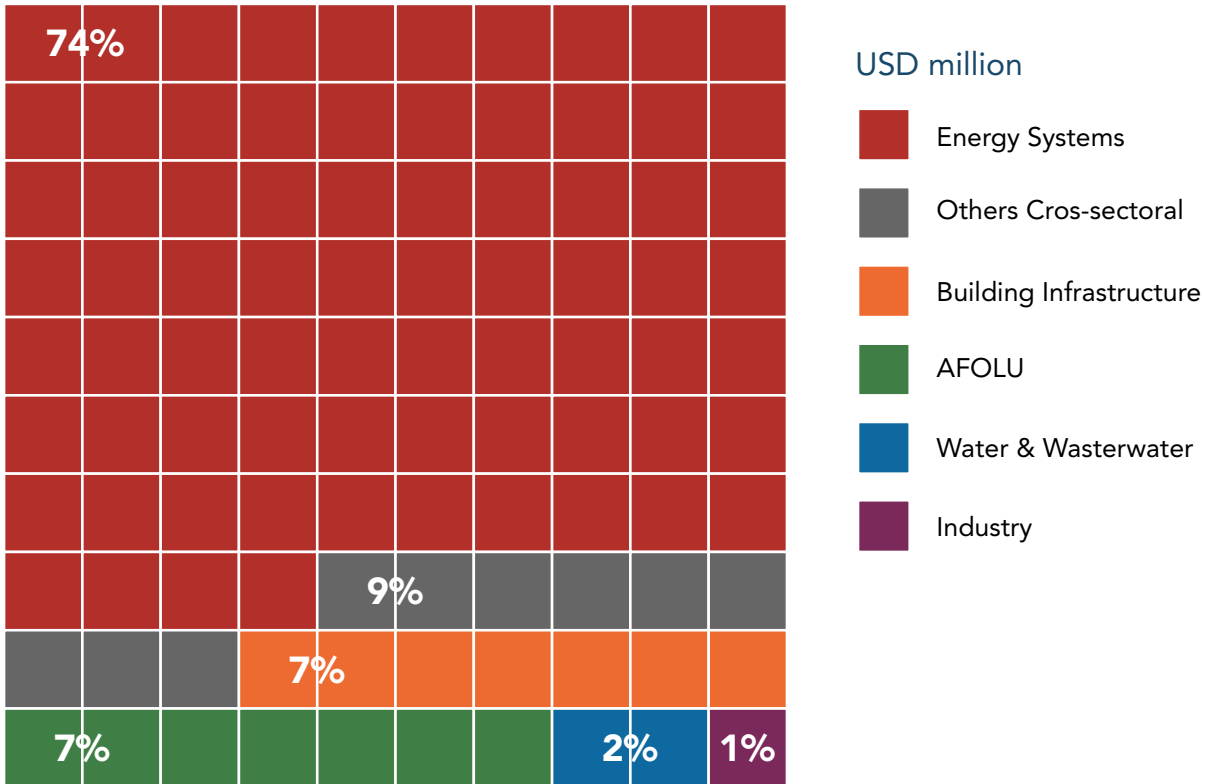
Moreover, interviews with 34 regional investors and climate change stakeholders suggested a far higher business survival rate than global norms, once local entrepreneurs are supported by the emerging startup ecosystem. Typically, 90 percent of small businesses fail within their first three years of business. Yet, one of the post-accelerator business development funds in Kenya reported that four years after its 2019 support round, 72 percent of the original entrepreneurial businesses were still operating.

Nonetheless, risk aversion continues to concentrate private investment flows into renewable energy, which offers a higher certainty and returns than most other areas of climate investment, attracting almost three-quarters of the continent’s private sector flows (see Figure 9, below). A key driver in this has been the guarantees, absorbing first losses on defaults, provided by donors and development finance institutions in this sector. Several fund managers reported that this emphasis, and the guarantees it has drawn, have also aligned with the priorities of investors

located in Europe and North America, where carbon reduction remains the top priority.

This has positioned philanthropists as the core funders of pre-seed, seed and venture investments in the region, with some fund managers suggesting they are the only international private actors that have invested in climate sectors beyond renewable energy.

Figure 10: Private climate finance by sector (2019/2020)



Source: [Landscape of Climate Finance in Africa, Climate Policy Initiative, 2022](#)

Commercial and private funds also appear to be deterred by the small scale of many investments. In interviews, investors cited their investment range in East Africa as typically less than \$1m. This echoed the findings of a 2023 survey of around 70 small and growing green businesses in Kenya by the Aspen Institute, which found that 24 had received no external investment, 10 percent reported grants and investments of \$1,000 to \$50,000, while 41 percent had received funding of \$100,000 to \$500,000, and a further 11 percent from \$500,000 to \$1m. Only 13 percent had received investments of over \$1m, which is the median average for global seed investments.

To support such small investments, several investors have created Special Purpose Vehicles (SPVs) holding a larger sum of funds that they then draw on for small loans, with the market often working through a range of pop-up SPVs, such as those set up by CleanTech and Off-Grid Finance.

But this still raises challenges in covering the costs of discovery. The investors interviewed reported frequent networking and information sharing with dedicated climate-investment groups, with pan-African angel investor networks playing a key role in amplifying information about emerging opportunities. Africa’s Impact Angel Network was cited as particularly key. However, the system demonstrated some elements of a closed loop. Many of those surveyed reported investing in the same few businesses, and while new initiatives such as the startup portal startupug.com have gathered a large reach - with 30,000+ members spanning more than 10,000 startups - the climate investment sector’s market linkages into the seedbeds of entrepreneurialism, as a whole, remain very limited.

Once identified, only around half of the entrepreneurs selected gain financial support, with the Aspen Institute reporting that 94 percent of the organisations actively supporting green entrepreneurs in Kenya

offer non-financial support, but only 52 percent offer financial support.

Furthermore, few are involved in climate adaptation. Agribusiness is the most common climate-related investment after renewable energy, but the agricultural engagement is often only loosely pegged to climate change, with investments including support for agro-processors, businesses that collect sub-standard harvests from farmers for processing, and those offering additional market linkages.

This breadth of definition around climate adaptation reflects the current norm for donors such as USAID and AfDB, who are engaged in building climate resilience in what are termed climate-responsive programmes in predominantly rural communities. These programmes provide agricultural extension services to increase knowhow and, sometimes, additional water and sanitation services. Many deliver climate change adaptation in only the broadest sense of addressing poverty and pursuing sustainable development goals - with the rationale being that they, thereby, make communities less vulnerable to climate change.

However, this broad approach to development goals as interchangeable with climate adaptation has fueled mounting global concern over the climate benefits flowing from such initiatives - in terms of specific emission cuts or adaptations to heat, drought and flooding. Indeed, one 2023 analysis by the Center for Global Development sparked international headlines on reporting that hundreds of the World Bank's 2,500 climate projects had almost nothing to do with climate change.

In this regard, the investors interviewed reported similarly broad definitions of climate adaptation. Almost all of those surveyed reported that interest in adaptation had only really arisen in the private investment community in recent months. This has seen several new funds, including funds such as the Cradles Fund, financing or launching new, adaptation-specific funds. However, this appears to have moved investors quickly into a similar broadening of adaptation to encompass any social or economic benefit, to the extent that one investor captured a general sentiment in explaining that a carbon reduction investment was also adaptation "because it has created jobs". Others managing adaptation funds spoke to their own difficulties in finding the connection to adaptation, with one manager of a new fund explaining that the opportunities, to date, had just proven stronger in mitigation and in agricultural value-chain initiatives.

A further barrier is around the nature of the early-adopters that comprise the region's private investment community. Across the three markets, Kenya has by far the largest investment ecosystem, with the support of entrepreneurs in both Uganda and

Ethiopia nascent until very recently. But the early entrants that populate the Kenyan market are predominantly focussed on digital businesses. Thus, their most common interface with climate adaptation is through information.

This saw investors highlighting projects that shared information about weather, information about soil nutrition, and information about water usage. But the space taken up by businesses providing drought-resistant inputs, soil enrichment technologies, or water creation was only sparsely populated.

Core climate innovation stakeholders reported that they were seeing few startups rooted in physical innovations. Yet this could be a matter of lens. One of the pan-African investors explained it didn't even log non-digital businesses, even where it did come across them, as they wouldn't qualify for consideration:



The only way these businesses can be scalable and have real prospects for growth, is if they are digital."

This has created an anomaly, said Bernard Laurendeau, who is currently working to prime and build the startup ecosystem in Ethiopia, where the private investment ecosystem "is actually distorting innovation". His point is supported by the emergence of more physical innovation businesses in Uganda and Ethiopia than are apparent in Kenya, suggesting that the current focus of early-stage funds on digital solutions is shaping the landscape of takeoffs.

In Uganda, where the Aspen Institute reported that, in 2018, there was almost no startup infrastructure, intense efforts through the Uganda Entrepreneurial Ecosystem Initiative (UEEI) have surfaced an array of physical innovations, such as Vepox, with its moringa filter water cleansing bottles and tanks, and Spout of Water, with its reincarnation of ceramic filters, adding to initiatives supported by philanthropists, such as Tusks Engineers' individual bio-latrines and fertiliser maker.

Vepox Filter: Offering low-cost water purification to curb water-borne diseases



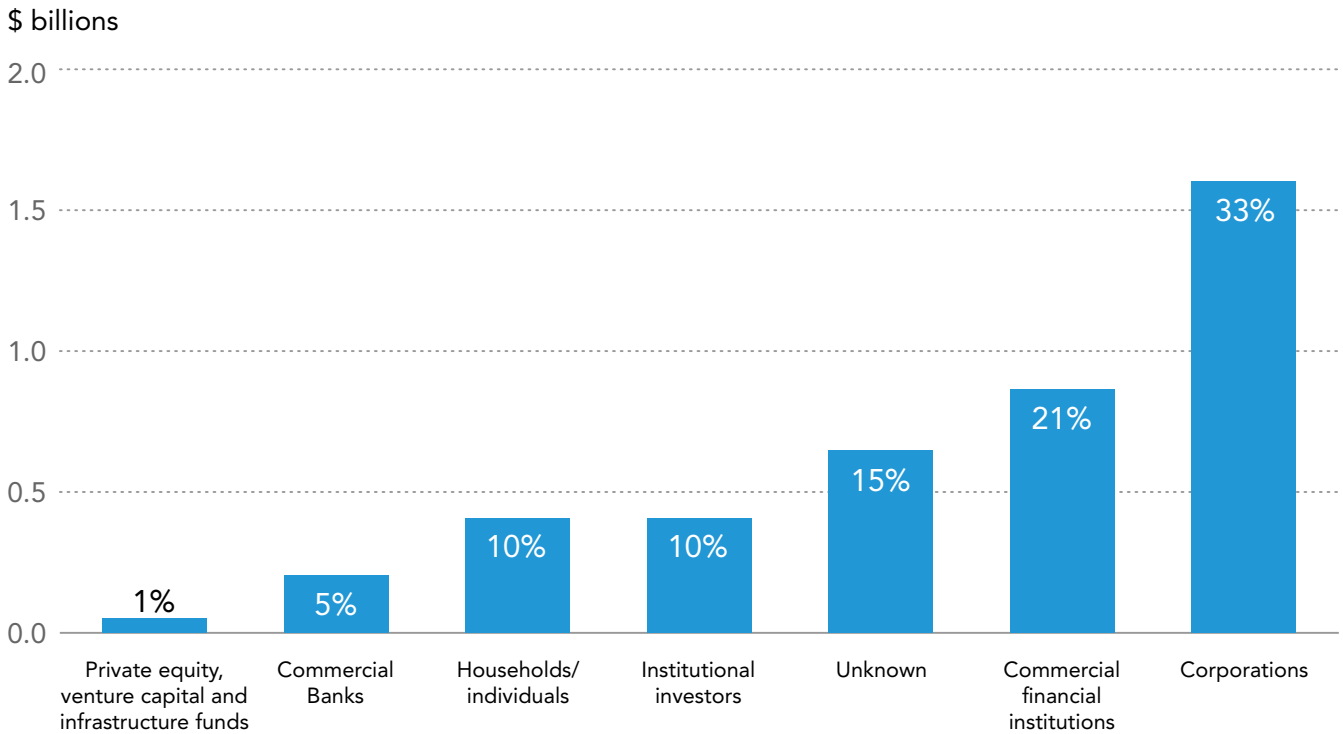
<p>The adaptation challenge</p>	<p>Climate change is leading to more waterborne diseases, as well as water scarcity and an increase in the usage of brackish water.</p>
<p>The enterprise solution</p>	<p>The Vepox filter was developed by the company's founders as young engineers at Makerere University. It combines three water filtration technologies using sand, bamboo-activated carbon, and moringa seed fibre, which together remove pathogens, chemicals, and dissolved ions. The company sells large water storage bottles for home use, with filters that last for three months, and small drinking water bottles with self-contained filters. It has set up a manufacturing plant for the filters in Uganda.</p>
<p>Finance and sustainability</p>	<p>The business has been funded by grants from UNICEF and Climate Launchpad. Its target is sustainability based on sales revenues from its filtered water containers and replacement cartridges.</p>
<p>The Impact</p>	<p>Vepox Filter has framed its impact primarily as a climate mitigation business, providing data on its impact in carbon reduction through removing the need to boil water. However, it provides health protection of a validated 99.9 percent, where 15 million Ugandans, or a third of the population, currently without access to clean drinking water, and water quality impacted by climate change.</p>

In Ethiopia, large-scale projects have brought private funding, such as the world's first and largest waste-to-power project in a park in Addis Ababa, but the country's top start-ups have quickly moved to a purely digital array, delivering mobile money transfers, online delivery services and edtech.

Yet, despite having by far the greatest number of climate-focussed incubators, accelerators and investment funds, Kenya has celebrated only an occasional star in physical innovation, from Majik Water (see case study) to Green Roads - which worked to create a space in Kenya for heat resistant roads made by adding recycled plastic to the asphalt.

Indeed, for all the emphasis on entrepreneurial ecosystems and routes-to-investment, private individuals are investing 16 times more in climate ventures in Africa than the entire array of private equity, venture capital and infrastructure funds, which are channelling just 1 percent of the continent's private climate finance.

Figure 11: Source of private climate finance flows in Africa, average 2019-20



Note: Percent refers to the share of each type of financing source in total private climate finance

Source: [Private Sector Financing For Climate Action And Green Growth In Africa](#), African Development Bank, 2023

For, even in the strongest markets, the ecosystem supporting private sector climate investment remains small. In 2022, Kenya had 176 organisations in green finance, of which half work exclusively with green entrepreneurs and half run general entrepreneurial programmes, that include green ventures. In 2023, Uganda had 12 local incubators, accelerators and entrepreneurship programmes, connected to a further 11 pan-African programmes and Ethiopia had two startup accelerators and two angel investment networks.

Most of these organisations fund across a wide remit of renewable energy, digital businesses and agribusiness, as well as carbon mitigation options for the transport and manufacturing industries. In East Africa, the investment in entrepreneurial adaptation remains, as yet, a tiny fraction of a small investment flow.





Conclusions



Priming private
sector investment
in climate adaptation
innovations In East Africa



Conclusions



Conclusions

The public sector has a vital role to play in creating an enabling environment for young businesses. But the idea that public sector spending can prime an explosion in private sector climate finance is rooted in assumptions that overlook key private sector constraints.

First among these are the prevailing norms in private sector risk assessment. These have meant that angel investors, freed from the need to justify investment choices to distant financiers and close to the reality of climate impact, have been a driving force in the region's private sector climate investment, as have the foundations run by global philanthropists.

By contrast, commercially accountable fund managers have clustered into renewable energy and general agricultural investments, where the returns are less complicated and more certain.

Investment in climate adaptation has further been constrained by the absence of standardised frameworks and definitions. This has seen general poverty alleviation emerge as the core of many adaptation programmes without metrics assessing its impact performance: thus preventing prioritisation and limiting entry by impact investors.

This gap is now beginning to draw attention, with early models such as the 2020 ASAP framework from the Lightsmith Group, laying out ways to measure SMEs' contribution to climate adaptation. But until such frameworks have become widely adopted, the lack of definition and impact assessment remains a key barrier.

The private sector also faces difficulties in priming new climate businesses. Limited business knowhow, limited awareness amongst potential entrepreneurs of business opportunities, and limited resources and means of discovery for potential investors have all constrained the pipeline of new climate adaptation businesses in East Africa.





This has been further exacerbated by the focus of attention on carbon reduction and the more muted public conversation on impact and adaptation, with dialogue at even the highest levels remaining largely limited to compensation for weather extremes, be it for those displaced by floods, or for those suffering agricultural losses as a result of drought.

Finally, the challenges for social enterprises in earning revenues in low-income markets are exacerbated by issues of value ownership on outputs such as cleaner air or mosquito proliferation. Few business models have yet got consumers to 'pay for clean air' as a product, although newer financing initiatives, such as the programme led by Aqua for All, are now offering payments to businesses for enhanced social and environmental impacts.

Together, the narrowed discussion, low public awareness, and structural difficulties in developing

appropriate businesses have combined to make for very limited entrepreneurial traction in climate change adaptation in East Africa.

However, the scale of the climate impact outlined in Chapter Two and the range of technologies now emerging that could protect East Africans from these changes, as outlined in Chapter Three, make for a compelling need to address the hindrances to the sector's business development.

Further revenue solutions may re-emerge, such as carbon credits for adaptation models that coincidentally reduce emissions. The circular economy models emerging in waste management also offer a convincing way forward. But, climate change entrepreneurs now need to innovate in both technology and revenue models with solutions that are unusually creative.

Fresh Life: Building the circular economy to make sewage safe from flooding



<p>The adaptation challenge</p>	<p>Increasingly frequent flooding is emptying the pit latrines used in low-income urban areas into the streets, causing cholera and other water-borne diseases.</p>
<p>The enterprise solution</p>	<p>The Sanergy Collaborative was started in 2011, as the Fresh Life non-profit and for-profit Regen Organics. Fresh Life provides waterless, self-contained toilet blocks in urban slums that are emptied up-to-daily by Fresh Life and transported to Regen Organics' processing plant, which feeds the sewage to insect larvae. The larvae are sold as high-protein animal feed, while the residue is composted and sold as organic fertiliser.</p>
<p>Finance and sustainability</p>	<p>The organisation's initial funding came from philanthropic and multilateral donors, including USAID, The Bill & Melinda Gates Foundation, and The Osprey Foundation. It provided toilet blocks without acquiring land or paying for space by leasing them to landowners to run as part of their businesses, charging minimally for toilet visits or as part of users' rents.</p> <p>Fresh Life saved on sanitation costs by using waterless units, and generated revenue streams onselling the waste to Regen Organics and by charging toilet operators a monthly subscription fee. It has also recently started supplying toilet blocks partially paid for by a municipal authority, in a financial partnership model to make the sanitation operation sustainable.</p>
<p>The Impact</p>	<p>By June 2023, Fresh Life was containing and removing sewage for 250,000 urban dwellers in 6,000 toilet blocks in the Kenyan cities of Nairobi, Kisumu and Eldoret, and adding 300 blocks a month. It is reducing urban water consumption, as well as water-borne diseases by ensuring the waste is treated by Regen Organics, and supplying Regen Organics with the feedstock for animal feed, which reduces the use of the normal feedstock, maize, helping increase food security.</p>

To engineer a stepchange in climate adaptation and benefits in East Africa will also require comprehensive efforts to raise awareness on the breadth of climate impact and volume of climate change interfaces, from water-borne diseases to cracked roads. For so long as climate adaptation remains within the purview of experts alone, few 20-year-olds will be spending time devising or developing pollution gobblers or soil moisturising solutions. It is vital that the understanding of climate impacts expands beyond a tight circle of specialists and NGOs into mainstream conversations, schools, media and policy debates.

The sector's business development further requires specific and relevant solutions to the constraints of risk management, drawing in business support as a sufficient backstop to prevent failure, and demonstrating through data and structured reporting the potential that exists for relatively secure investments.

The ecosystem, further, needs considerable expansion. As it is, the early stage entrepreneurial support structures in Kenya, Uganda and Ethiopia are delivering live businesses and competent business managers. But the progressive multiplication of more of the same, one small hub at a time, will be a journey of decades, in a situation where the clock is at five minutes to midnight. Hubs need to develop platforms that relay potential business ideas, gather hundreds of thousands of business opportunities, and connect with hundreds of thousands of financial backers, within an amplified framework of non-financial support: whether through e-learning, certification, or partnerships with the Training and Vocational Education sector.



On this basis, we recommend:

01 — The launch of comprehensive national and local information campaigns, driven by government entities and private sector organisations, to raise awareness on climate impacts and their business solutions, attract entrepreneurs, and advance climate innovation markets;

02 — The development of an investment-sector, collective website listing all areas where business solutions are needed to address climate impacts in East Africa, offering crowd-sourced listings of entrepreneurs seeking to engage in climate businesses, and providing a knowledge base on climate businesses under development, as well as pan-African insights on innovative business models that could apply in adaptation. The website would aim to ease the difficulty for investors and support networks in identifying potential candidates for support, and mobilise, inspire and facilitate climate adaptation entrepreneurs;

03 — The development of a public-private initiative, potentially with an organisation such as KenTrade, KenInvest, of Financial Sector Deepening and a firm within the financial or investment ecosystem, to produce an annual business risk report on climate adaptation businesses, providing an accurate assessment of the drivers, markers, and levels of business risks for investors in such businesses in East Africa, with metrics and comparatives;

04 — The pursuit by African angel networks, foundations, philanthropic and other investment organisations of blended finance, with partnerships that catalyse private investment in climate adaptation, either by offsetting risk or by increasing earning potential, through platforms that engage a variety of capital providers, following the models of platforms such as Prime Coalition and affiliate funds like Azolla, in climate mitigation, to draw in a wider pool of investors into climate adaptation.



05

Partnerships and development of all existing business knowledge programmes, through the Training and Vocational Education sector, existing hubs and accelerators, and other knowledge-building programmes, to pool and extend curricula and training resources, with the aim of driving increased reach to potential entrepreneurs. The pursuit by African angel networks, foundations, philanthropic and other investment organisations of blended finance, with partnerships that catalyse private investment in climate adaptation, either by offsetting risk or by increasing earning potential, through platforms that engage a variety of capital providers, following the models of platforms such as Prime Coalition and affiliate funds like Azolla, in climate mitigation, to draw in a wider pool of investors into climate adaptation.



Further to these recommendations, the research for this report raised many questions that would merit further investigation. No framework is yet available for assessing the impact of climate change in the region through the consideration of the multiple and variable health effects of rising temperature and extremes, or the impact on buildings and all types of infrastructure. Mobilising resources to address such impacts is considerably hindered by the absence of any tool encompassing each aspect and pathway of climate change impact.

Another limitation that is receiving greater attention is the potential scale of off-radar private and public sector climate investment. However, as means are developed to tag these flows, the gap around definitions and qualifying conditions for such investments is opening the door to the potential of greenwashing. This is seeing some activities classified as climate adaptation that do not, in fact, offset any direct impact of climate change, but, instead, are related to other agendas.

Finally, this report was limited by the absence of information around potential climate adaptation investments. Despite the excellent work being undertaken by the Aspen Institute and others in assessing the ecosystem for green entrepreneurship, these remain focussed on a far wider remit around a broad array of environmental issues, rather than on any exploration of the specific investment pipelines in climate impact.

In sum, the challenge ahead is to achieve a focus on climate impact across all specialisms and roles, be it in health, engineering, agriculture or investment, and from all touch-points, from government policy to community work, and knowledge platforms to investment support.

Until then, the most profound limitation in conducting this report was simply an apparent 'blind spot' in all domains to climate impact, leaving it without codification or informed mobilisation.



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