

# Masterclass on Climate Adaptation Finance

## Session 4: Adaptation Solutions



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## Trainer



**Danilo Amaral Cançado *Climate Adaptation and Resilience Expert***

8 years of experience in climate adaptation and infrastructure projects in Africa, Asia, Latin America and Caribbean. Certified Climate Finance Expert.

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## Agenda

- Adaptation vs. mitigation: distinctions, co-benefits, and risks of maladaptation
- Economic and strategic case for investing in adaptation
- Sector-specific risks and solutions

## Context for the Masterclass



Climate change presents both serious threats and strategic opportunities for financial institutions (FIs).

As physical and transition climate risks intensify, they can severely disrupt **lending operations, erode asset values, increase default rates, and ultimately undermine financial stability**.

However, the same risks also pave the way for **new business opportunities** in adaptation finance and **climate-resilient investments**.

### Learning outcome

- *Distinguish between adaptation and mitigation, and identify areas of overlap and co-benefits*
- *Evaluate the economic, social, and environmental benefits of climate adaptation (triple dividend)*
- *Identify key climate hazards and sector-specific risks relevant to financial institutions*
- *Match sector-specific adaptation needs with viable financial product opportunities*



Module 4: Where to Invest –  
Adaptation Needs, Finance  
Solutions & Tools

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# The Masterclass on Climate Adaptation Finance



**Purpose:** Global Center on Adaptation (GCA) and European Bank for Reconstruction and Development (EBRD) in partnership with Frankfurt School of Finance & Management, RebelGroup, and Haskoning develop the Masterclass to engage the private sector in climate adaptation finance, unlocking market growth, protecting portfolios, and creating long-term value through innovative tools. The Masterclass positions adaptation as both a strategic opportunity and a risk management priority.

The Masterclass is built on a 6-module Body of Knowledge (BoK) to equip financial institutions (FIs) to understand physical climate risks and design bankable adaptation investments that build resilience, align with national priorities, and benefit millions of people.

M1: Rationale for Investing in Adaptation

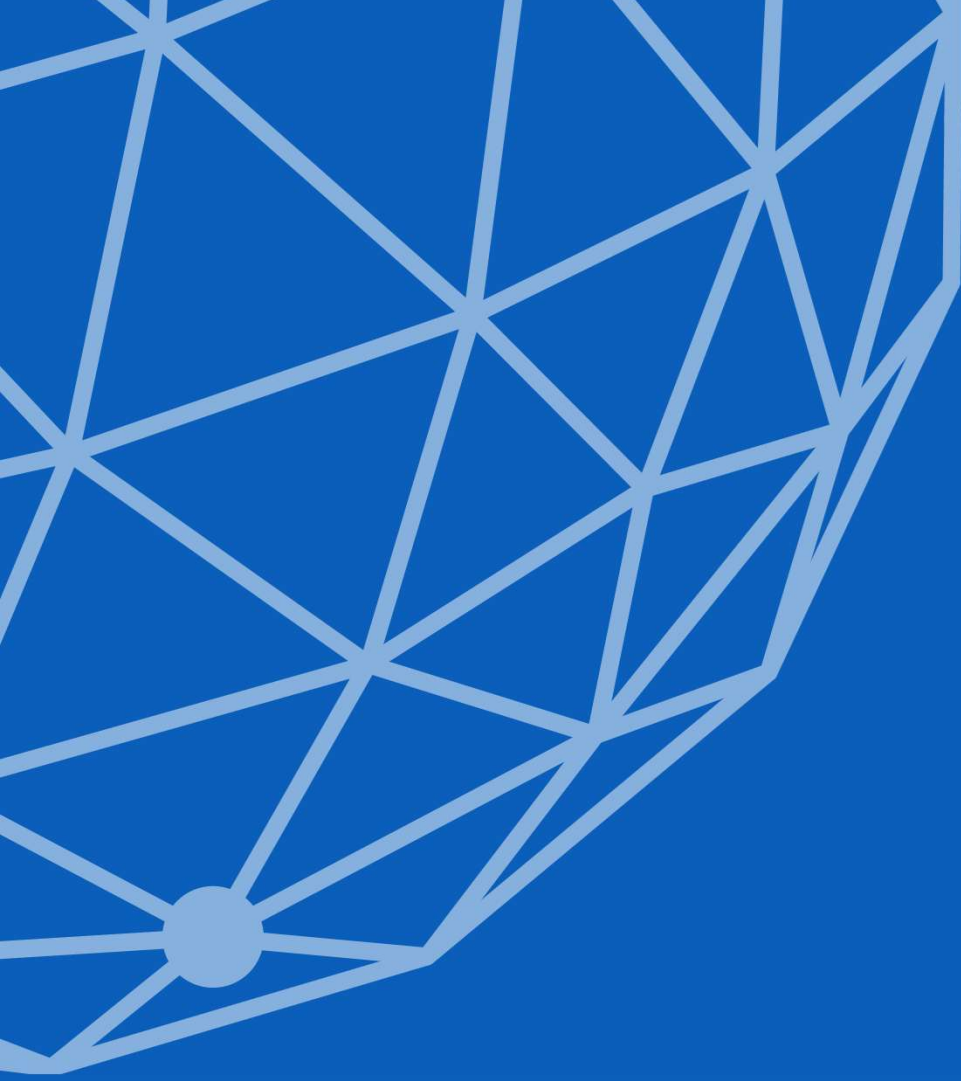
M2: Understanding Climate Change Science: what FIs\* must know

M3: Climate Risk Modeling for FIs

M4: Adaptation Needs, Finance Solutions & Tools

M5: Climate Adaptation Product and Pipeline Development in FIs

M6: Stakeholder Engagement and Policy Support for Scalable Climate Finance



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## Session 4

Types of adaptation solutions

Economic and strategic case for investing in adaptation

Sector-specific risks and solutions

# Types of Adaptation Solutions

## Physical Measures

*Structural (grey/green/hybrid)  
NBS, technologies, systems*



- **1st Dividend** – Avoided losses.
- **2nd Dividend** – Productivity and resilience gains.
- **3rd Dividend** – Environmental co-benefits

## Non-Physical Measures

*Operations, educational,  
information, people, behavior*



- **1st Dividend** – Faster recovery from shocks.
- **2nd Dividend** – Improved workforce health and productivity.
- **3rd Dividend** – Inclusion, empowerment of local communities.

## Institutional Measures

*Governance, economics, policy,  
regulation, and programs*



- **1st Dividend** – Lower exposure via planning & regulation.
- **2nd Dividend** – Incentivized climate-smart investment.
- **3rd Dividend** – Governance, systems strengthening.

# Types of Adaptation Solutions

## Physical Measures

### Definition:

- Include traditional engineering solutions, nature-based solutions, and technological advancements that address the impacts of climate change

### Examples:

- Water saving technologies, including rainwater harvesting.
- Water desalination.
- Urban drainage systems.
- Mangrove restoration, coral reefs.
- Seawalls and sea defence structures.
- Ecological protection, including floodplain conservation and ecological corridors.



*Two Ecosystem-based Adaptation (EbA) projects were implemented to address adaptation needs in Dar-es-Salaam and coastal districts*



*Sea defence structures*

# Types of Adaptation Solutions

## Non-Physical Measures

### Definition:

- Are related to services (i.e., disaster response), involvement vulnerable communities or groups, and the implementation of community-based adaptation measures or locally led interventions.

### Examples:

- Awareness raising and integrating climate change into education.
- Participatory action research, social learning, and community surveys.
- Disaster warning comms.
- Knowledge-sharing platforms to exchange climate adaptation (and mitigation) solutions.
- Technical training in climate and vulnerability mapping and assessments.

**LESSONS LEARNED**

### Climate Adaptation in Tanzania with Ecosystem Restoration & Flood Defence Infrastructure

UNEP Lessons in Climate Change Adaptation

| PROJECT NAME                                                                                                                                                                                                                                            | LOCATION                                                                                                                               | EXECUTING AGENCY                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| 1. Developing core capacity to address adaptation to climate change in productive coastal zones (GEF ID 4141)<br>2. Implementation of concrete adaptation measures to reduce vulnerability of livelihoods and economy of coastal communities (AFB 2048) | UNITED REPUBLIC OF TANZANIA<br>Pangani, Mikumi, Bagamoyo, Dar es Salaam                                                                | Vice President's Office, Government of Tanzania        |
| IMPLEMENTING AGENCY                                                                                                                                                                                                                                     | MAIN APPROACHES                                                                                                                        | FUND                                                   |
| UNEP                                                                                                                                                                                                                                                    | Flood defence infrastructure<br>Ecosystem-based adaptation<br>Scientific & technical capacity<br>Public engagement & awareness raising | Least Developed Countries Fund (GEF) & Adaptation Fund |
| BUDGET                                                                                                                                                                                                                                                  |                                                                                                                                        | SDGs                                                   |
| GEF: \$3.36m, plus co-finance of \$41.9m<br>AF: \$4.62m                                                                                                                                                                                                 |                                                                                                                                        | TIMEFRAME                                              |
|                                                                                                                                                                                                                                                         |                                                                                                                                        | 2012-2019                                              |

Lessons Learned Climate Adaptation in Tanzania



She Leads Green Action Program: Empowering young women to address climate change challenges in Tanzania



Flood warnings via SMS and chalkboards in Dar es Salaam, Tanzania

# Types of Adaptation Solutions

## Institutional Measures

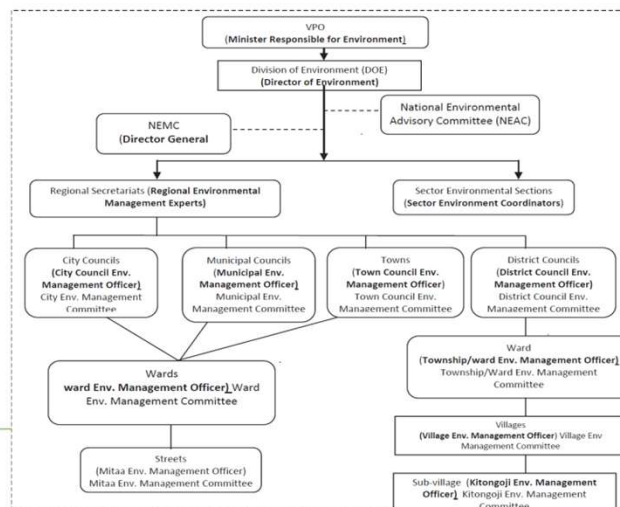
### Definition:

- Include policies, plans, strategies, regulations, and financial instruments that stimulate the adoption of climate adaptation measures.

### Examples:

- Financial incentives including taxes and subsidies for adaptation.
- Provision of insurance including index-based weather insurance schemes.
- Establishment of payments for ecosystem services.
- Implementation of disaster contingency funds.

Representation of existing institutional arrangement for environmental management



GCF DOCUMENTATION

## Readiness Proposal

with UNDP for the United Republic of Tanzania  
13 August 2021



Proposal to strengthen adaptive and resilience capacities by facilitating the integration of climate change adaptation planning processes

THE UNITED REPUBLIC OF TANZANIA  
VICE PRESIDENT'S OFFICE

## NATIONALLY DETERMINED CONTRIBUTION

JULY, 2021

Nationally Determined Contribution Tanzania

## Key principles to consider when identifying adaptation solutions



Adaptation options are **context and location specific**. There is not a 'one size fits all' approach.



Adaptation options must be **environmentally integrated** so that it does not cause any other damage (maladaptation).



Adaptation is about understanding **what the problem is** (the physical hazard creating a risk), **what should be done about it** (the adaptation solution) and **what the result is** (the outcome).



Any adaptation action requires **stakeholder engagement** to ensure awareness and a sense of ownership.



Adaptation investments must be **protected by design**, integrating climate hazards and risks from the outset.



Adaptation options requires **continuous learning** to optimize the ability to cope with what is ahead.

## Quiz Question

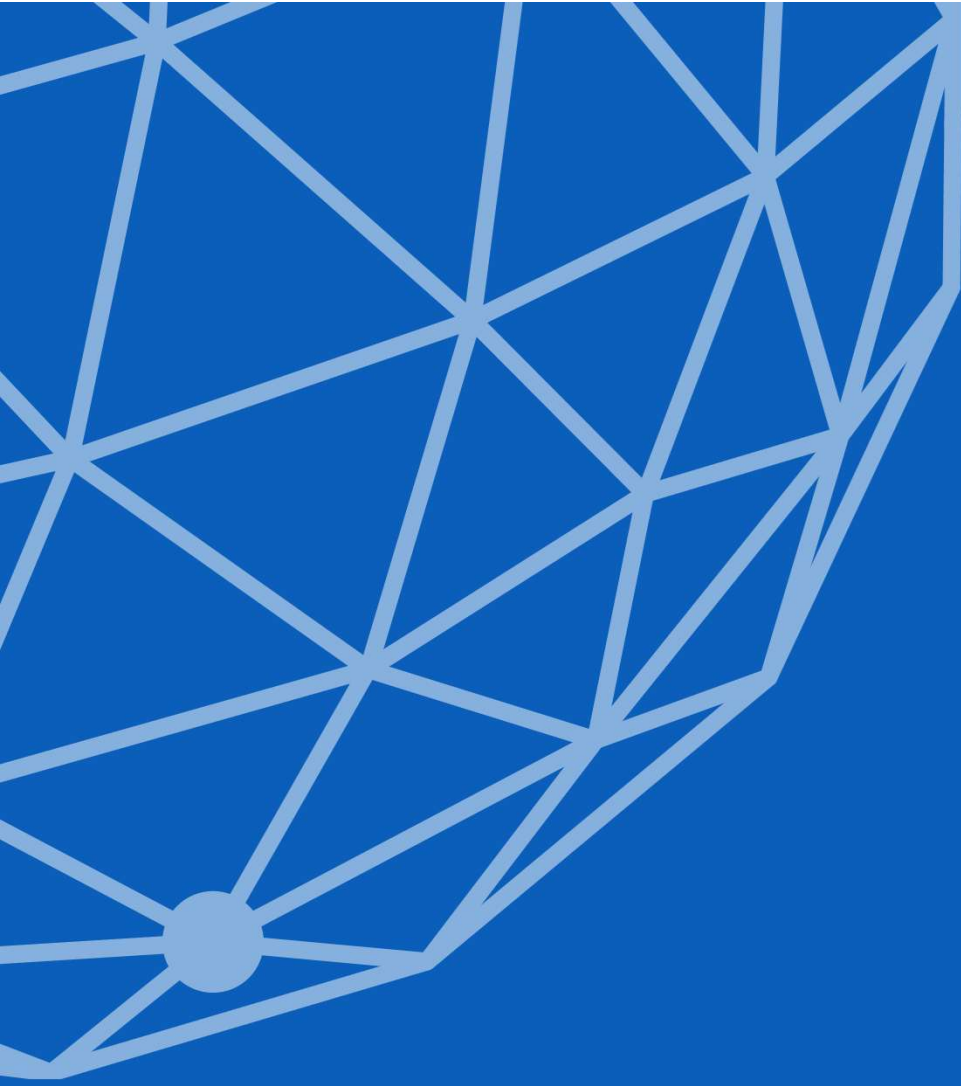


Institutional adaptation measures primarily deliver their strongest benefits by increasing short-term productivity gains at the project level rather than by reducing exposure to climate risks through policy, planning, and regulation.

A) True

B) False

Institutional measures mainly act by shaping rules, incentives, and governance systems that lower climate exposure and guide long-term investment decisions, rather than by generating immediate productivity gains at the project level.



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## Session 4

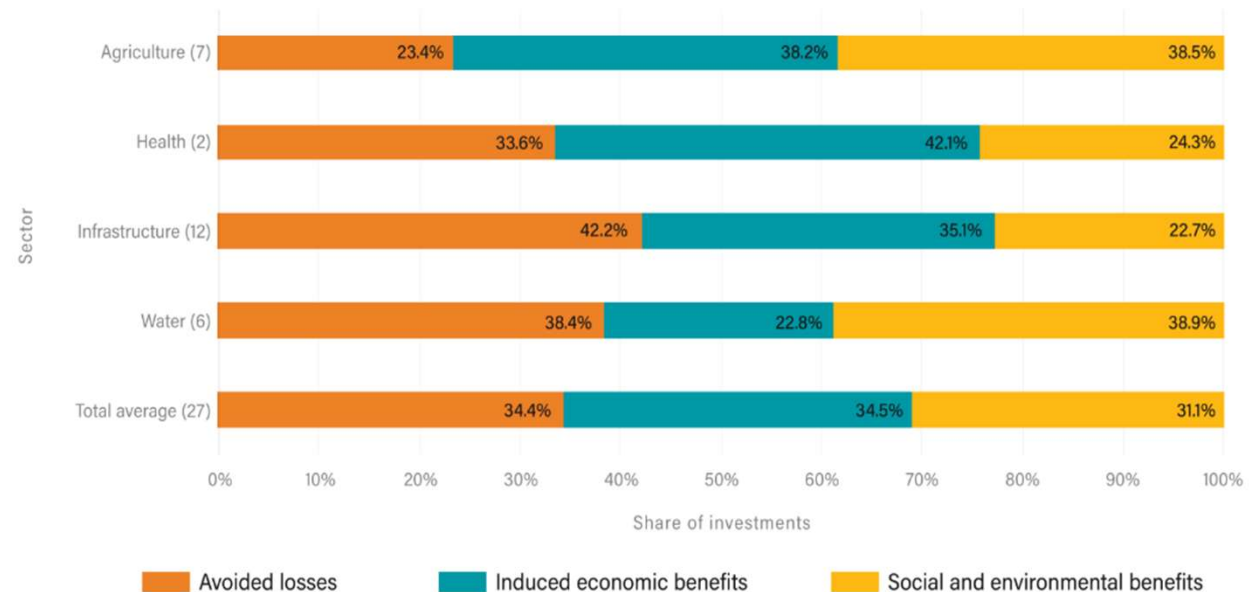
Types of adaptation solutions

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## Triple Dividend of Investing in Adaptation

- **Avoided losses:** Integrating climate risk considerations into investment decisions not only protects assets but also enhances long-term returns.
- **Operational savings and economic gains:** Investing in climate-resilient infrastructure and technologies can generate significant long-term economic benefits by reducing both capital and operating expenditures over time.
- **Environmental and social co-benefits:** The rehabilitation and protection of mangroves not only reduces the losses and damages from flood events, but also contributes to increasing fisheries production, forestry conservation, and recreational spaces for the population.



## Strategic Importance of Investing in Adaptation

### Risk Mitigation

Protects portfolios by reducing defaults, asset losses, and climate-related disruptions

### Builds Resilience & Position as a leader

Enhances long-term stability and establishes leadership in sustainable finance by driving investment in adaptation

### Generates Returns/reduces costs

Creates profitable products while optimizing operational efficiency

### Unlocks Capital

Expands funding opportunities and access to climate-aligned finance

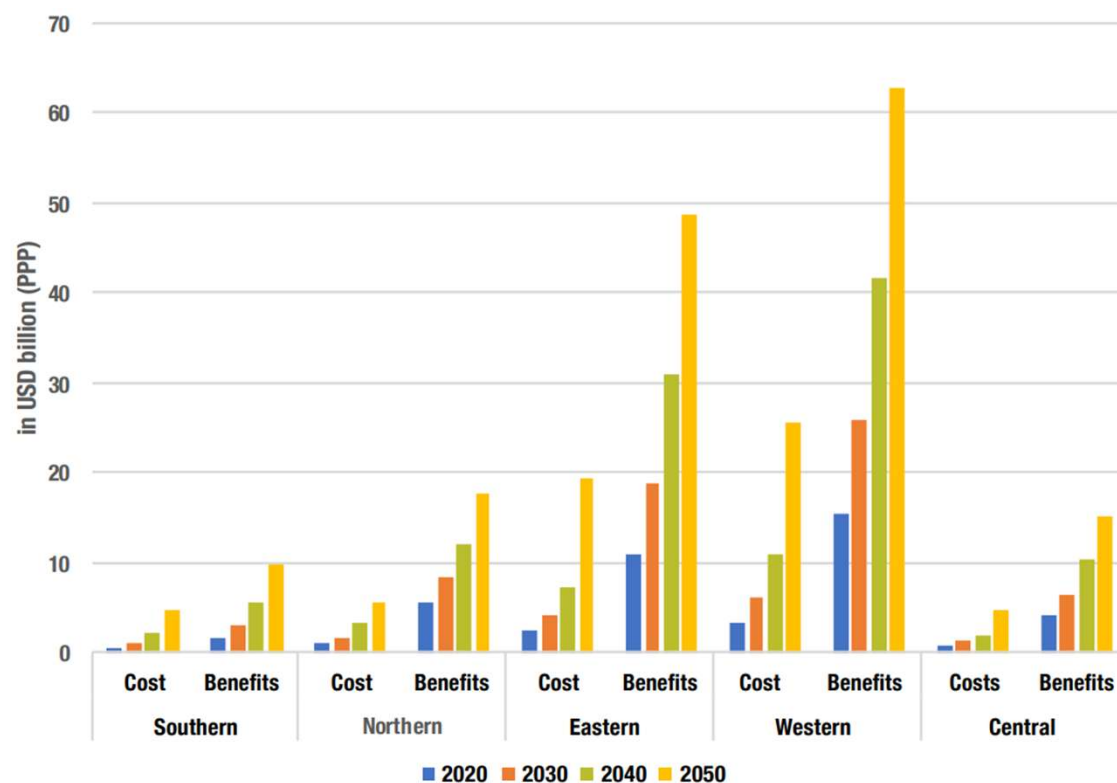
### Examples:

- **Portfolio risk mitigation:** When FIs lend specifically for activities that improve resilience to extreme weather events, these borrowers become better equipped to withstand the adverse effects of climate change, leading to more stable financial performance and greater repayment reliability.
- **Unlocking new revenue streams:** For instance, new pay-as-you-go service providers of modular, off-grid solar pumps and drip lines on small farms, both shield farmers against rainfall variability and rising diesel prices, boosting yields of cash crops, and provide revenue generation opportunities from metered water payments, bundled input sales, and potential carbon/renewable-energy credits.

## Costs and benefits of investing in adaptation solutions

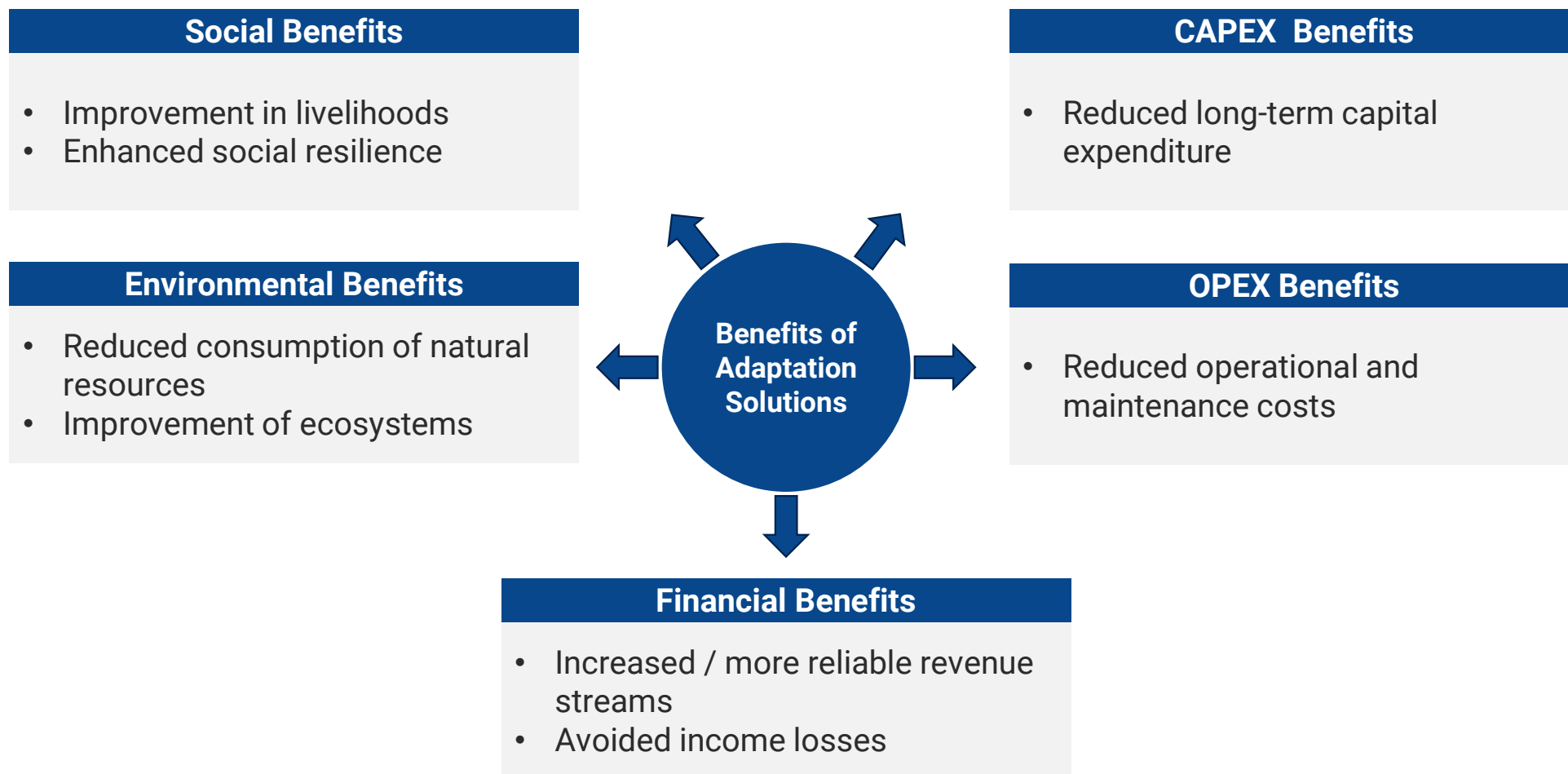
- The costing of adaptation solutions needs to be based on **local materials and the availability of capacity or resources** for implementing and maintaining such measures.
- Variation in material costs due to limited resources or dependency on a single source, taxation rules affect products of technologies, and overall disruptions in supply chains, can **affect the costs of solutions**.
- Similarly, the benefits of adaptation solutions will also vary depending on **how much they can reduce climate risks**, and on the intensity and frequency of climate hazard events over the investment lifecycle.

*Costs (represented by damages) and benefits of investing in climate adaptation across regions in Africa and time horizons.*

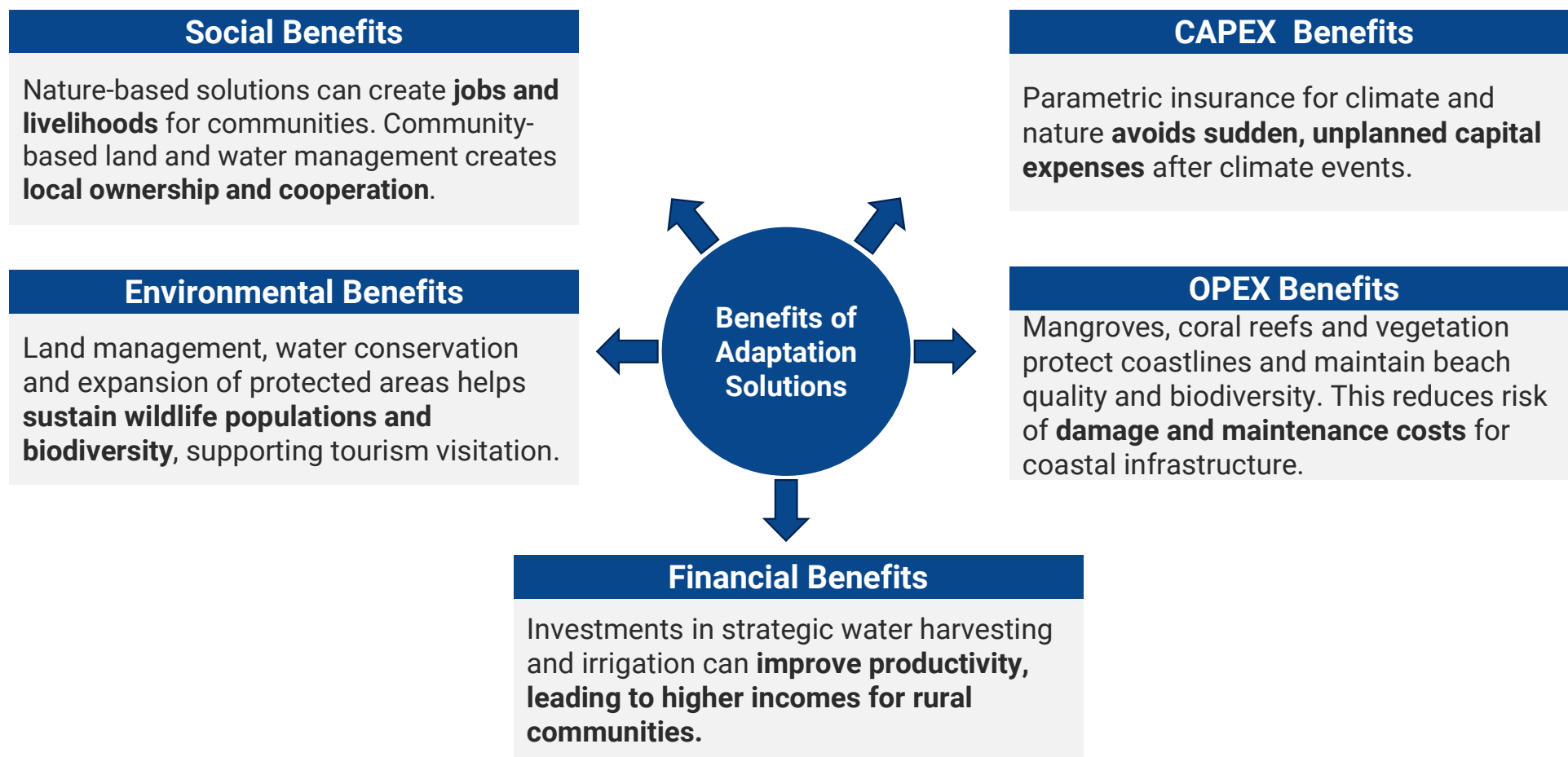


Source: (AfDB, 2019).

## Costs and benefits of investing in adaptation solutions



## Costs and benefits of investing in adaptation solutions



## Quiz Question

Which statement best captures how adaptation investments can simultaneously reduce both CAPEX and OPEX over time?

A) Nature-based solutions reduce operational and maintenance costs while also avoiding sudden, unplanned capital expenditures after climate shocks.

B) Adaptation investments mainly increase upfront capital costs but have little effect on long-term operating expenses.

C) Financial benefits of adaptation are limited to social outcomes and do not affect infrastructure spending.

D) Parametric insurance increases operational costs but stabilizes revenue streams only in the short term.

Adaptation measures like nature-based solutions and parametric insurance lower maintenance needs and prevent large, unexpected capital outlays following climate events, improving cost efficiency across both CAPEX and OPEX.



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## Session 4

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## Sectors Hazards and Risks – Agriculture



### Climate Hazards and Risks

#### Agriculture

- **Heat-related illnesses** of livestock increasing animal care costs.
- **Reduced rainfall and persistent droughts** leading to reduced grazing land, livestock death and destruction of crops.
- **Rising sea levels** causing soil salinization, saltwater intrusion and higher groundwater tables leading to waterlogging, contamination, and reduced yields.
- Drought increasing **food insecurity**, heightening existing malnutrition rates.
- Higher temperatures increasing **incidents of pests and animal disease outbreak**.
- Change in crop yields and livestock death **leading to reduced income, loss of livelihoods** and loss of assets.
- Climate changes **shifting and reducing viable areas** for cash- and other- crops.

### Examples in Tanzania

#### Agriculture

- The number of animals currently living in drought-affected areas amounts to 11 million units (21%).<sup>1</sup>
- Agricultural economic losses from climate change impacts are estimated at US\$200 million every year.<sup>2</sup>
- 43% of the Tanzanian population are under nourished directly because of drought related food shortages.<sup>2</sup>
- The drought which occurred in the year 2005/06 caused famine and led to loss of livestock in semi-arid areas.<sup>2</sup>
- The livelihoods of about 80% of Tanzanians depend on the agriculture, forestry and fisheries resources.<sup>2</sup>
- Coffee exports are expected to be severely affected by higher temperatures where yields are expected to drop from 225/ha to about 145 by 2060.<sup>2</sup>

Source:  
1. CIWA. (n.d.). Drought Resilience Profiles. <[https://www.ciwaprogram.org/wp-content/uploads/SADRI\\_Drought\\_Resilience\\_Profile\\_Tanzania.pdf](https://www.ciwaprogram.org/wp-content/uploads/SADRI_Drought_Resilience_Profile_Tanzania.pdf)>.  
2. Irish Aid. (2018). Tanzania Country Climate Change Risk Assessment Report. <<https://www.ied.org/sites/default/files/pdfs/2023-11/22086g.pdf>>.

## Adaptation Solutions – Agriculture

- **Digital Climate Advisory Services (DCAS)**, including weather and seasonal forecasts and farmer-to-farmer training.
- Integrating **climate adaptation into agricultural planning** for crop-specific strategies.
- **Solar-Powered Irrigation Systems.**
- **Cold Chain Infrastructure (Milk Chilling & Preservation)**
- **Crop diversification, crop rotations and inter-cropping.**
- Water management: **Rainwater harvesting and retention.**
- **Post-harvest solutions:** Hermetic Storage Systems, Solar Drying Systems.



## Sectors Hazards and Risks – Housing & Real Estate and Transport



### Climate Hazards and Risks

#### Housing & Real Estate

- **Flooding causing building damage**, particularly in informal settlements, resulting in financial, physical and emotional losses.
- **Frequent flooding** of major cities **undermining affordability and growth** for rising population.
- Increased disasters leading to **displacement and forced migration**.
- Flooding **increasing risk and transmission of vector borne disease** in urban environments.

#### Transport

- Flooding causing **physical damage to key transportation** links.
- Flooding **disrupting access of labor markets, trade and freight**.
- Frequent inundation and coastal flooding causing **damage and increased degradation** of roads, bridges and protective structures, resulting in higher maintenance and replacement costs.

### Examples in Tanzania

#### Real Estate

- Approximately 463km<sup>2</sup> of Tanzania's built-up urban area is at high risk of fluvial or pluvial flooding or sea level rise.<sup>1</sup>
- In Dar es Salaam, 80% of residents live in unplanned, informal settlements.<sup>1</sup>
- Serious floods in 2009 and 2010 in Kilosa and 2011 in Dar es Salaam led to displacement of thousands, loss of life, destruction of properties, railways, roads and bridges.<sup>2</sup>

#### Transport

- In 2000, 1.3 % of major roads were exposed to river floods at least once a year.<sup>3</sup>
- It is estimated that worst-case disruptions to Tanzania's multi-modal transport networks due to extreme flooding, could cause losses of up to \$1.4 million per day.<sup>4</sup>

1. World Bank. (2024). Country Climate and Development Report. <<https://openknowledge.worldbank.org/server/api/core/bitstreams/88aeb5df-33be-4ccc-8aca-2ad9d0f814bd/content>>.

2. Irish Aid. (2018). Tanzania Country Climate Change Risk Assessment Report. <<https://www.ied.org/sites/default/files/pdfs/2023-11/22086g.pdf>>.

3. GIZ. (2021). Climate Risk Profile: Tanzania. <[https://www.adaptationcommunity.net/wp-content/uploads/2021/02/GIZ\\_Climate-Risk-Profile-Tanzania\\_EN\\_final.pdf](https://www.adaptationcommunity.net/wp-content/uploads/2021/02/GIZ_Climate-Risk-Profile-Tanzania_EN_final.pdf)>.

4. Rweyendela, A. G. & Mwegoha, W. J. (2021). Climate change is a threat to Africa's transport systems, in DownToEarth. <<https://www.downtoearth.org.in/africa/climate-change-is-a-threat-to-africa-s-transport-systems-what-must-be-done-77402>>.

## Adaptation Solutions – Housing and Real Estate

- Incorporate climate-resilience into **standards, design guidelines** and building codes.
- **Upgrade urban drainage systems.**
- **Integrate protective infrastructure**, including elevated sidewalks and retaining walls.
- **Enhance strategic infrastructure**, such as roads that facilitate evacuation during emergencies.
- **Strengthen local government capacity** (human and financial) to manage urban growth and implement development plans.
- **Encourage grassroots action** by integrating community-led data collection and co-design of solutions into projects.
- **Improve access to affordable financing and materials** for resilient construction.



## Adaptation Solutions – Transport

- **Improved access to multi-modal transportation.**
- **Climate-proofing existing infrastructure,** including elevation of transport corridors and asphaltting.
- **Improved urban drainage and flood protection** along key corridors.
- **Consistent monitoring** of infrastructure conditions and proactive maintenance.
- **Strengthen institutional capacity** to manage climate risks, conduct assessments, and support project implementation.
- **Improved climate data and tools** to inform decision-making.



## Sectors Hazards and Risks – Energy and Water



### Climate Hazards and Risks

#### Energy

- **Increase evaporation and drought** impacting the reliability of hydropower energy supply.
- Power outages leading to **increased costs to operate back-up generators**.
- Land degradation and flooding leading to **increased runoff and sedimentation**, impacting the operation of hydropower plants.
- Land degradation and land-use change **reducing forestry resources available** for energy.

#### Water

- **Increased water temperatures** causing rise in waterborne diseases, bacteria and algae blooms, increasing treatment needs.
- **Saltwater intrusion into aquifers** threatening freshwater quality.
- **Drought, rainfall patterns and high temperatures reducing river flows**, impacting water availability, resulting in water stress, increased prevalence of illness and greater time to collect water.

### Examples in Tanzania

#### Energy

- A prolonged dry spell in October 2015, for example, led to a near cessation of hydropower production across the country. Under current climate conditions, a loss of 15.6 million USD is expected on average once every 5 years.<sup>1</sup>
- A drought in 2005/06 led water shortage for hydropower generation leading to power rationing and unpredicted black outs.<sup>2</sup>
- The economic cost of power shortages (running backup generators and foregone production) for Tanzania, is estimated at over 4% of GDP annually.<sup>2</sup>

#### Water

- Mountain Kilimanjaro has lost 80% of its ice cover between 1912 and 2000, reducing river in-flows.<sup>3</sup>
- Over the past 50 years, there has been an extreme decrease of water levels of Lake Victoria and Lake Tanganyika, and the 7-km recession of Lake Rukwa.<sup>4</sup>

1. CIWA. (n.d.). Drought Resilience Profiles. <[https://www.ciwaprogram.org/wp-content/uploads/SADRL\\_Drought\\_Resilience\\_Profile\\_Tanzania.pdf](https://www.ciwaprogram.org/wp-content/uploads/SADRL_Drought_Resilience_Profile_Tanzania.pdf)>.

2. Irish Aid. (2018). Tanzania Country Climate Change Risk Assessment Report. <<https://www.iied.org/sites/default/files/pdfs/2023-11/22086g.pdf>>.

3. Volunteer Africa. (2021). How is Climate change affecting Tanzania. <<https://volunteerafrica.fi/climate-change-in-tanzania/#:~:text=Agriculture%20and%20Food%20Security,production%20have%20impacted%20food%20security.>>.

4. GIZ. (2021). Climate Risk Profile: Tanzania. <[https://www.adaptationcommunity.net/wp-content/uploads/2021/02/GIZ\\_Climate-Risk-Profile-Tanzania\\_EN\\_final.pdf](https://www.adaptationcommunity.net/wp-content/uploads/2021/02/GIZ_Climate-Risk-Profile-Tanzania_EN_final.pdf)>.

## Adaptation Solutions – Energy

- **Improve access to electricity and small-scale sustainable energy sources** to reduce reliance on firewood and charcoal.
- **Promote energy-saving stoves** and biogas for electricity and meal preparation
- **Expand energy transmission infrastructure** to improve wellbeing of communities.
- **Elevate or relocate** key energy transmission and supply infrastructure to reduce impacts from inundation.
- **Diversification of energy sources** to reduce vulnerability due to reliance on hydropower and reduce risk of outages due to unreliable supply.
- **Improved access to data** and integration with EWS to enable improved prediction of capacity and energy supply.



## Adaptation Solutions – Water

- **Improve and expand drainage** and stormwater infrastructure (including retention basins).
- **Expand accessibility of water supply** and wastewater facilities/infrastructure.
- **Water savings and loss reduction technologies** (incl. rainwater harvesting).
- **Investments in National Meteorological and Hydrological Services (NMHSs)** in Tanzania to enhance data collection and improve forecasting capabilities and drought early-warning systems (DEWS).
- **Disaster risk reduction education, capacity-building and awareness campaigns** to improve understanding and ability to react to warning messages.



## Sectors Hazards and Risks – Forestry and Tourism



### Climate Hazards and Risks

#### Forestry

- **Loss of habitat** impacting ecosystem services and natural asset-based economic activity.
- **High magnitude of projected habitat loss** resulting in loss of carbon sinks.
- Flooding coupled with land-clearing **increasing erosion and further degradation.**

#### Tourism

- **Degradation and fragmentation of forest habitat** impacting wildlife migratory patterns.
- Coastal flooding and sea-level rise **increasing rates of shoreline erosion** and loss of coastal wetlands.
- Higher temperatures **shifting disease vectors or disease pathogens**, increasing risk of animal and vegetation illness.
- **Shifts in rainfall** affecting vegetation and wildlife, impacting eco-tourism and adventure tourism.

### Examples in Tanzania

#### Forestry

- Annual estimates of emissions due to deforestation of Tanzania's forests range from 44 MtCO<sub>2</sub>e to 80 MtCO<sub>2</sub>e.<sup>1</sup>
- Tanzania's natural capital per capita decreased by 51% from 1995 to 2018, driven by a decrease of fisheries (74%), pastureland (67%), protected areas (56%), cropland (54%), and forests (43%).<sup>1</sup>

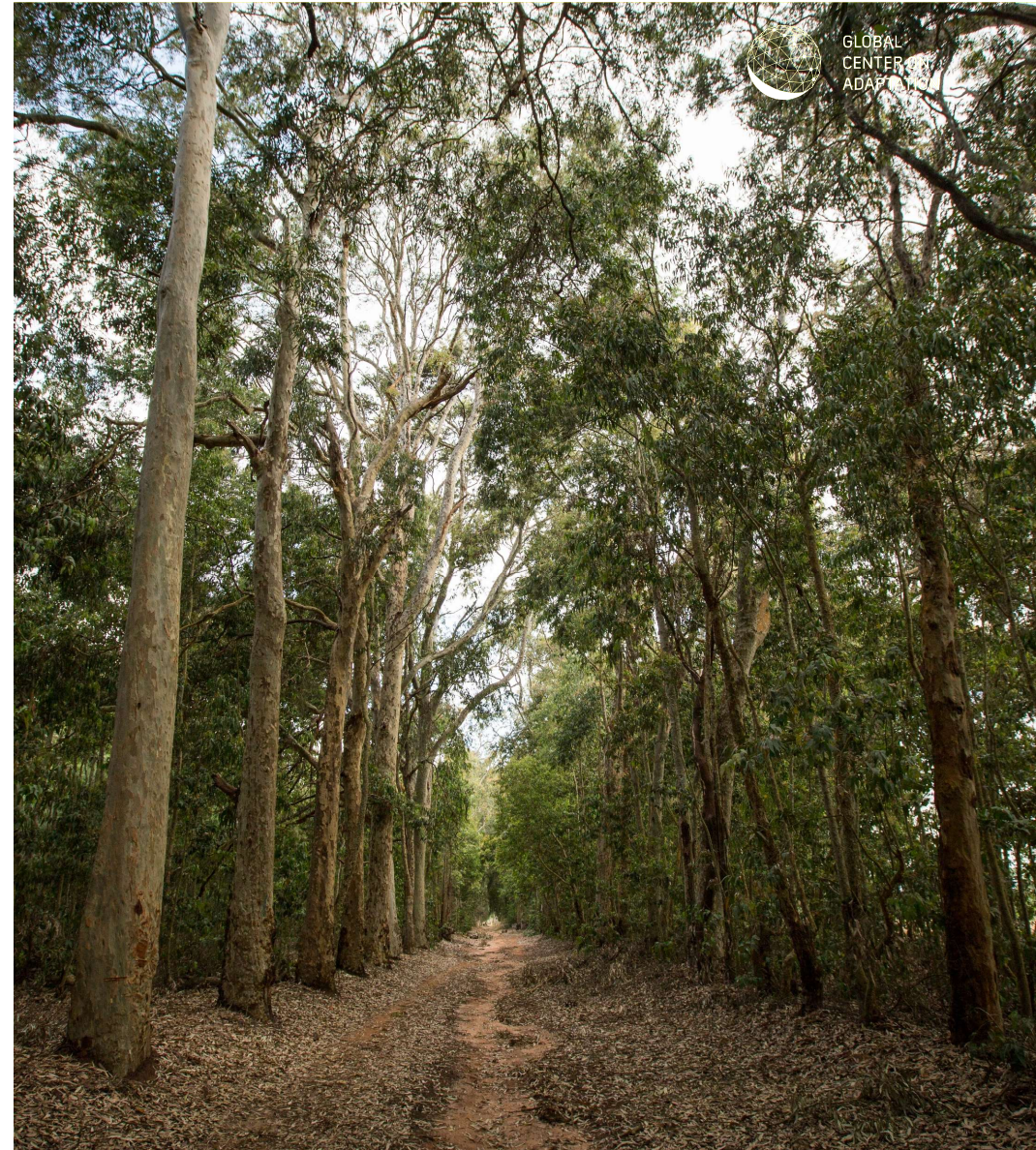
#### Tourism.

- Glacial retreat on Mount Kilimanjaro has already resulted in changes in land cover (from montane forest to heathland) and species composition (Kilungu et al. 2017).<sup>1</sup>
- In the Lake Victoria Basin, 71–78 percent of the 233 native freshwater fish species are vulnerable to climate change.<sup>1</sup>

1. World Bank. (2024). Country Climate and Development Report. <<https://openknowledge.worldbank.org/server/api/core/bitstreams/88aeb5df-33be-4ccc-8aca-2ad9d0f814bd/content>>.

## Adaptation Solutions – Forestry

- **Agroforestry** to create diverse systems.
- **Support communities to diversify income streams** through non-timber forest-related products.
- **Reforestation and conservation** to restore degraded areas and strengthen resilience.
- **Enhanced forest management through institutional and policy strengthening.**
- **Promote energy-saving stoves** and biogas for electricity and meal preparation.
- Support **improved harvesting and processing of forest products** through education and capacity-building.
- **Promote community involvement** in the management of forests to ensure long-term sustainability.



## Adaptation Solutions – Tourism

- **Restoration and protection of coral reefs and coastal ecosystems** which act as natural infrastructure, reducing the need for expensive engineered defenses like seawalls.
- **Increase area of strategic protected land** to preserve migratory patterns and critical habitats.
- **Community-led projects** require lower upfront investment than traditional tourism infrastructure and offer high social and environmental returns.
- **Greater investment in tourism** to increase economic and employment opportunities, improving natural capital and community-perception of ecosystem value.
- **Establish integrated management approach** across agriculture, grazing, timber, protected areas and water storage to improve productivity and long-term sustainability.



## Recap

1

Adaptation solutions can be **physical, social or institutional.**

2

Costing needs to be based on **local materials and the availability of resources.**

3

Benefits vary depending on **how much solutions can reduce climate risks.**

4

Adaptation activities are **context specific.**

5

Adaptation activities need to be aligned to **sectoral needs.**

6

Adaptation options requires **continuous learning.**

## Quiz Question

Which adaptation investment most directly reduces climate risk by combining improved forecasting with faster response to droughts at a national scale?

A) Solar-powered irrigation systems for smallholder farmers

B) Expansion of cold-chain infrastructure for agricultural products

C) Crop diversification and intercropping at farm level

D) Investments in National Meteorological and Hydrological Services (NMHSs) and drought early-warning systems

Strengthening meteorological and hydrological services improves climate data, forecasting, and early warnings, enabling timely, system-wide responses to drought risk rather than only farm-level coping measures.



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