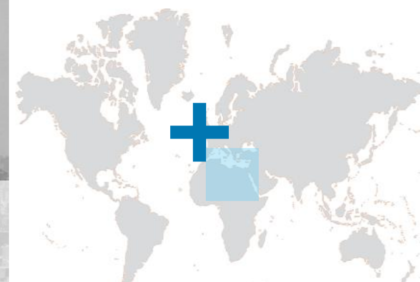
Enhancing Risk Assessment for Improved Country Risk Financing Strategy



Egypt

A Policy Brief

Introduction and context

Climate change is disrupting economies and livelihoods globally, with developing countries like Egypt among the hardest hit. Increasing extreme heat and flood events threaten food security and economic stability. For example, *Egypt's agricultural output is projected to decline by up to 18% by 2030, with consumer food prices potentially rising up to 24% under high-emissions (RCP8.5) climate scenarios*.

Such climate pressures, combined with existing vulnerabilities, pose significant risks to poverty reduction and development gains. However, climate risk impacts, both direct and indirect, remain challenging to quantify. Direct impacts of climate risk events, such as the impact of adverse weather conditions on agriculture or the damage to productive assets and business interruptions, cause economic losses through loss of income, productivity, and employment, negatively impacting GDP. Indirect impacts are even more challenging to quantify. Consider, for example, the adverse health impact of heatwaves on the population and the associated costs, or the costs of students missing school due to a flood. Hence, planning effective adaptation and risk financing strategies is particularly challenging, as it requires a comprehensive understanding of both the direct economic losses and the broader non-monetary impacts on sectors such as health, education, and overall livelihoods.

The ERA Project in Egypt

To address these challenges, the *Enhancing Risk Assessments (ERA) for Improved Country Risk Financing Strategies* project was initiated as a partnership between the Government of Egypt (represented by the Financial Regulatory Authority, FRA), the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and United Nations University – Institute for Environment and Human Security (UNU-EHS)/Munich Climate Insurance Initiative (MCII).

The ERA project delivers a new generation of climate risk assessment to inform Egypt's climate change adaptation planning and disaster risk financing strategies. The project applied the *Economics of Climate Adaptation (ECA) analytical framework* together with the open-source *CLIMADA modeling platform*, providing a probabilistic outlook of current and future climate risks, and evaluating the cost-effectiveness of adaptation options.

Importantly, the analysis was extended beyond economic losses to also quantify "non-economic" impacts, which were identified and selected by the stakeholders during the kick-off workshop, such as reduced accessibility to health services or education, and reduced mobility. Additionally, as traditional risk models do not tend to account for economy-wide effects, a *Dynamic General Equilibrium model for Climate Resilient Economic Development (DGE-CRED)* was integra-

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الهيئة العامة للرقابة المالية FINANCIAL REGULATORY AUTHORITY ted into CLIMADA to assess how macroeconomic indicators are impacted by climate change.

Finally, the project developed a Graphical User Interface called *RISK WISE* as a tool to assist decision making, allowing stakeholders to interactively explore the results and visualize the outcomes (e.g., by selecting hazard scenarios, assets at risk, and adaptation measures).

This integrated approach – combining risk analytics with macroeconomic modeling and an accessible interface – provides a robust foundation for evidence-based climate resilience planning and risk financing in Egypt.

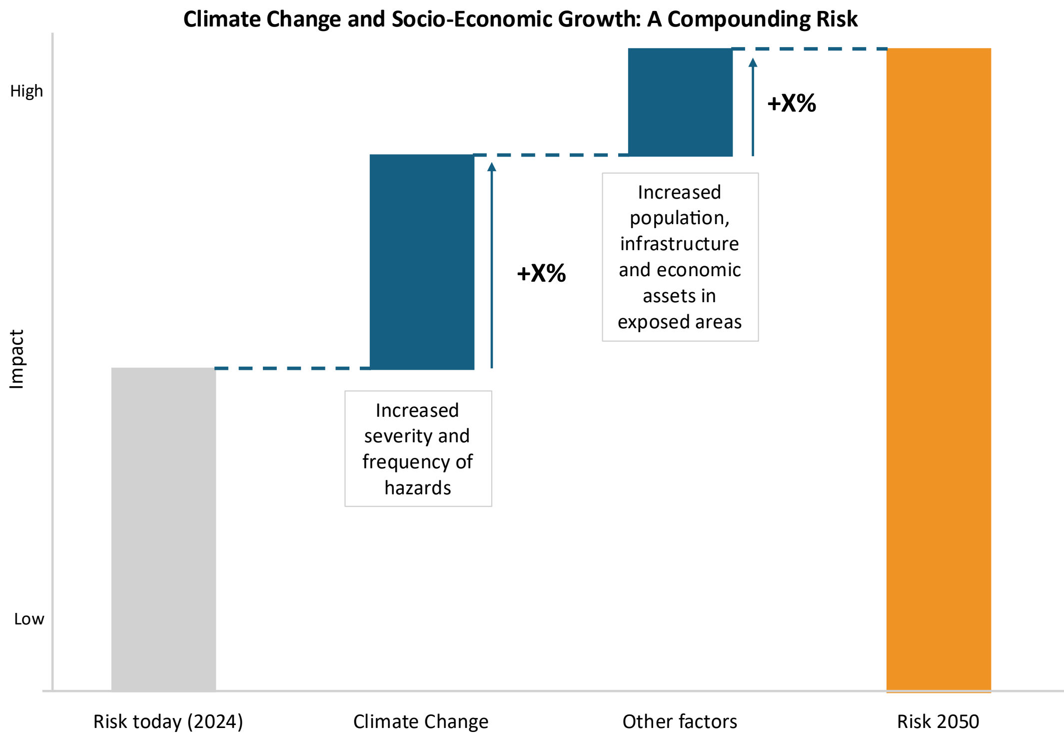
Trends in Climate Hazards and Exposure Patterns

The ERA assessment focused on two hazards for Egypt: *extreme heatwaves* and *heavy precipitation leading to flash floods* (with projections also considering more frequent riverine floods in the future). The analysis examined impacts looking ahead to 2050 under different climate scenarios: a moderate-emissions scenario with ~2°C warming, and a high-emissions scenario with ~2.4°C warming by 2041–2050.

- **Heatwaves:** Extreme heat is an immediate and growing threat. Many regions already experience prolonged heatwaves, and *by mid-century southern and central areas (e.g., parts of Asyut, Sohag, Qena, Luxor) could see 70–90 days of heatwave exposure per year.* Urban centers are particularly vulnerable as rising temperatures drive up energy demand (for cooling) and put strain on infrastructure and public services.
- **Floods:** While catastrophic floods are currently less frequent than heat extremes, *flood risk is projected to increase significantly in coming decades*. Heavier rainfall events and overflowing of the Nile will make flash floods and riverine floods more common by 2050. Almost the entire Egyptian population lives along the Nile River and its delta, which exposes them and their assets to flood risk. *Even under a moderate climate scenario, annual expected damages from flooding and heat combined are estimated at around USD 28.7 million*; *under a high-emissions scenario this could rise to USD 66.2 million in annual losses by 2050.* These figures underscore the rising cost of inaction.

Climate Change and Socio-Economic Growth: A Compounding Risk

The ERA team used CLIMADA to simulate climate impacts under different future climate scenarios (up to 2050), both with and without socio-economic growth. The results show that while both drivers independently increase the risk, together they multiply it, which is a contributing factor in the sharp increase in projected damages.



For example, flood damages are projected by the CLIMADA Model to rise from about USD 42,500 per year now to well over USD 66 million per year by 2050 (RCP 8.5), a 1,500-fold increase. This is not only due to more severe floods, but also because more assets and people will be in harm's way due to economic development and urban expansion. New infrastructure (e.g., cities in desert areas) may face unexpected flash flood risk if drainage is inadequate. Densely populated, previously low-risk regions may now face amplified climate threats due to urban sprawl and informal settlement expansion.

The interaction of socio-economic growth and climate change leads to a compounding of risk in Egypt.
Even if climate hazards remained constant, the increasing concentration of people and economic value in vulnerable areas would raise climate-related losses.

Macroeconomic Implications for Egypt

Looking at the economy, *climate change will perhaps be the biggest challenge for Egypt's economic growth trajectory* over the coming decades. The integrated DGE-CRED macroeconomic model assessed how recurring disasters (heatwaves and floods) could compound over time:

- Under a high-emissions scenario, *the cumulative impact of climate hazards could reduce GDP growth by about 0.3% leading up to 2050*, compared to a hypothetical baseline scenario without climate shocks. Key industries like agriculture, energy, and tourism are projected to suffer the largest losses, which in turn drags down related sectors with negative consequences for overall employment. Climate impacts are not one-off events – *repeated shocks have long-lasting effects* that can depress investment and productivity, creating a persistent gap in the economy's output.

- This projection of growing losses underscores that without adaptation, climate change could erode decades of development gains as well as fiscal stability. However, the modeling also delivers a hopeful message: investing in adaptation can significantly offset these impacts, projecting scenarios where effective adaptation measures can half the economic losses. For instance, tree planting, followed by the construction of retention reservoirs and the dredging of canals, emerges as the most cost-effective strategy for mitigating future flood damage. Implementing these three measures would effectively address Egypt's total flood risk for economic assets. Initiative-taking adaptation does not only avoid damage in an immediate sense, but preserves long-term growth potential. The study highlights timely adaptation as crucial to prevent climate shocks from disrupting Egypt's economic development.

In summary, the ERA project's risk assessment paints a stark picture of escalating climate risk to Egypt's economy and society. Yet it also demonstrates that early and sustained adaptation efforts could significantly reduce these risks.

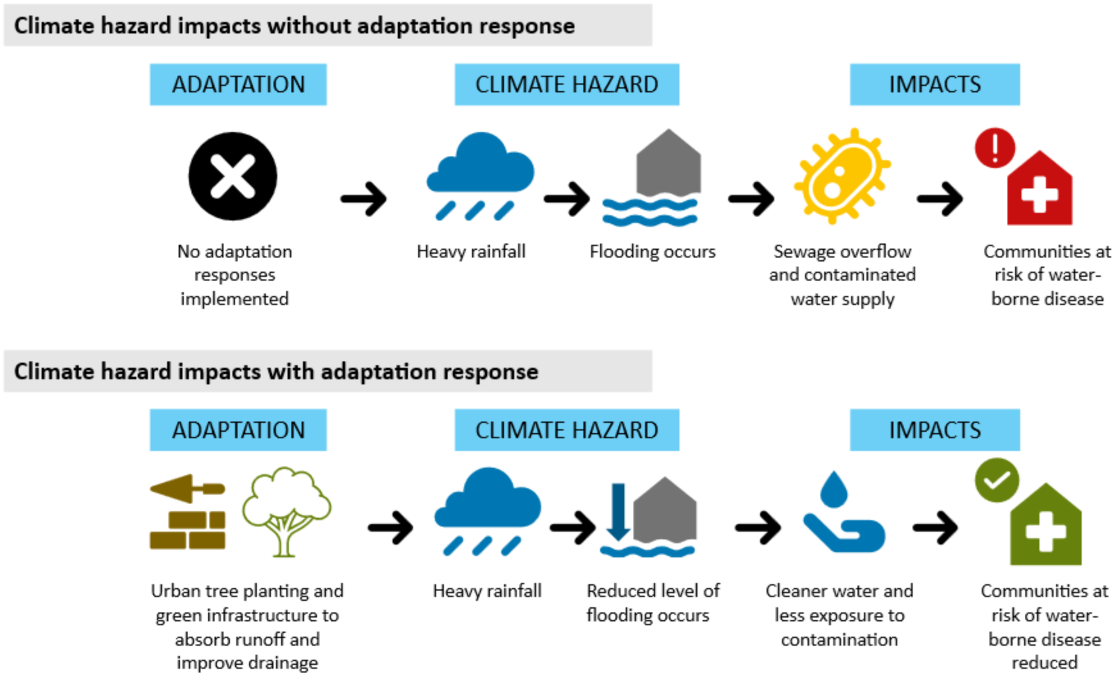
Projected Compounding Risk and Potential Impact of Adaptation

To manage these escalating risks, Egypt has a wide range of adaptation options. Adaptation strategies are crucial for **addressing the pressing climate challenges** Egypt faces, including the severe impacts of floods and heatwaves. They help in **reducing potential damage** from extreme weather events and are designed to **lower the intensity or frequency of these effects**, decrease the vulnerability of assets, or reduce the number of affected assets and populations.

As can be seen from the above, the impact of climate risk in Egypt would be exacerbated by the socio-economic growth expected up to 2050. Therefore, adaptation efforts and strategies must be implemented to mitigate the potential impact of climate risks and minimise their effects.

The following table summarizes the compounding effects of climate risks and socio-economic drivers up to 2050 and impacts of adaptation efforts:

Impact Category	Compounding Risks	Current Impact (projected in 2024)	Projected Impact – Without Adaptation (in 2050, RCP 8.5 + Growth)	Potential Impact of Adaptation Efforts
Economic Damages (Floods)	Climate Risks + Economic Growth	Up to USD 42,500 in annual losses (approx.)	Up to USD 66 million in annual losses	Tree planting, building retention reservoirs and dredging canals are the most cost-effective strategies for mitigating future flood damage. **Implementing these three measures would effectively address Egypt's total flood risk for economic assets.**
Health Risk (Diarrhea from Floods)	Flood Intensity + Informal Settlements Growth	109,000 people affected per year (approx.)	313,000 people affected in 2050 alone (approx.)	**Every USD 1,000 invested in tree planting could reduce the number of diarrhea cases caused by flooding by almost 25**, making it the most cost-effective flood-related health impact reduction strategy evaluated.
Education Disruptions (Students Affected) due to Floods and Heatwaves	More Frequent Floods + Population Growth	Floods: 112,000 students impacted Heatwaves: 672,000 students impacted	Floods: 1,784,000 students impacted in 2050 (approx.) Heatwave: 1,150,000 students impacted in 2050 (approx.)	For heatwaves, green roofing is likely to reduce the number of students impacted and enhance their well-being but for floods the adaptation efforts may have only modest impact.
Mobility Disruptions (Road Users) due to Floods	Urban Growth + Road Network Expansion	183,000 users per year (approx.)	253,690 users impacted in 2050 alone (approx.)	Even with careful implementation of **all seven identified adaptation measures** for floods these efforts would **still be insufficient to address the total flood risk** for road users.



Inter-Linkages between Climate Hazards, Vulnerable Assets, Adaptation Responses, and the Emergent Benefits

Adaptation Measures for Flood and Heat Risks and their Cost-Benefit Assessments

The ERA analysis applied a systematic framework to identify and evaluate the most effective adaptation measures across sectors. Starting from an extensive list of 49 potential adaptation interventions (29 for floods, 20 for heat), the project narrowed it to 15 high-priority measures: 7 focused on flood risk and 8 on heatwave risk, deemed most relevant and feasible for Egypt.

These measures span a spectrum of approaches, including **"Grey" infrastructure** (i.e. engineered structures), **Nature-based Solutions** (NbS) that leverage existing ecosystems, **Hybrid measures** that combine green and grey techniques, **Systemic measures** (policies, capacity-building, and community programs) and **Risk financing instruments** (like insurance and microinsurance).

The following table provides a summary of the cost-benefit estimates for selected measures that address both floods and heat, which often overlap, through a cost-benefit analysis using the CLIMADA model to simulate the Annual Average Impact up to 2050.

Each measure's cost has been estimated based on Egyptian data or localized international benchmarks, representing the investment (including maintenance) needed from now to 2050 to implement at scale.

Adaptation Measures Category	Flood Management Measures	Heat Management Measures	Key Cost-Benefit Insights
Systemic Measures Policies, capacity-building, and community programs	**Flood Early Warning Systems (EWS)** ▪ Monitoring and forecasting systems ▪ Advanced warning communications ▪ **Cost: USD 2.6 million**	**Heat Early Warning Systems** ▪ Like flood EWS for extreme heat events ▪ **Cost: USD 22.4 million** **Farmer Training Programs** ▪ Adaptation of agricultural practices ▪ **Cost: USD 79.9 million** **Water-Saving Irrigation** ▪ Drip irrigation and rainwater harvesting ▪ **Cost: USD 75.6 million** **Climate Research & Monitoring** ▪ Enhanced data collection and climate services ▪ **Cost: USD 14.2 million** **Heat-Resilient Building Codes** ▪ Updated thermal performance standards ▪ **Cost: USD 436.8 million**	▪ **Highest Return on Investment:** Early Warning Systems deliver 10:1 benefit-cost ratios globally ▪ Climate research and farmer training rank as most cost-effective after EWS ▪ Building codes require high upfront investment but ensure long-term resilience
Nature-based Solutions Leveraging existing ecosystems	**Afforestation/Tree Planting** ▪ Absorbs rainwater and reduces runoff ▪ Soil stabilization ▪ **Cost: USD 69 million**	**Urban Greening** ▪ Shade trees and urban forests ▪ Microclimate cooling ▪ **Cost: USD 69 million** **Green Roofs** ▪ Vegetative building insulation ▪ **Cost: USD 11.4 million**	▪ **Most cost-effective for flood risks** ▪ Could avert a major proportion of projected 2050 flood losses to economic assets ▪ Tree planting prevents 25 cases of flood-related illness per USD 1,000 invested ▪ Significant public health gains projected

Hybrid Measures Combining green and grey techniques	**Retention Reservoirs** ▪ Capture excess run-off for gradual release ▪ **Cost: USD 10.7 million** **Infiltration Ponds** ▪ Permeable systems for groundwater recharge ▪ **Cost: USD 52.5 million** **Recharging Wells** ▪ Direct floodwater channeling to aquifers ▪ **Cost: USD 77.7 million**	**Climate-Smart Agriculture (CSA)** ▪ Comprehensive resilient farming practices ▪ **Cost: USD 251.4 million**	▪ **High effectiveness** when combined with Nature-based Solutions ▪ Optimal balance of natural and engineered approaches ▪ Cost-effective flood risk reduction
Grey Infrastructure Engineered solutions	**Small Flood Dams** ▪ Upstream capture and flow moderation ▪ **Cost: USD 168.1 million** **Canal Dredging** ▪ Regular debris and silt removal ▪ **Cost: USD 40.3 million**	*No specific heat measures identified*	▪ **Regional effectiveness:** Major benefits projected for Upper Egypt and Nile Delta ▪ Low-tech solutions with significant impact ▪ Cost-effective for specific geographic areas

Key Policy Recommendations

Building climate resilience in Egypt is **not the mandate of a single ministry or sector** – it requires integrated, all-of-government action. Floods and heatwaves affect agriculture, water, housing, health, education, transport, finance and more, so effective adaptation demands that these domains work in concert. ERA's conclusions consistently emphasize cross-sectoral coordination as the linchpin for success.

Based on the insights generated through the ERA project, the following policy recommendations aim to support managing and financing of climate risk adaptation in Egypt by addressing both short-term priorities (actions that can be initiated immediately for quick benefits) and long-term strategies (systemic changes and investments for sustained resilience). They are tailored to national policymakers, local implementers, and supporting partners (donors and development agencies), and are organized into cross-cutting initiatives and sector-specific actions.

Key policy recommendations for Egypt include:

1. **Strengthening Inter-Ministerial Climate Governance:** Strengthen inter-ministerial climate governance by activating the National Council for Climate Change (NCCC) – an inter-ministerial committee for climate policy – as the central hub for adaptation planning. With a clear mandate and division of responsibilities across key ministries (environment, water, agriculture, housing, health, finance, defense, etc.), it can drive a unified National Adaptation Plan, prevent fragmented efforts, and ensure coordinated climate resilience.

2. **Integrating Adaptation into Development Planning and Budgeting:** Integrate adaptation into Egypt's development planning and budgeting by embedding climate risk measures in national plans, sector strategies, and public investments. Infrastructure should be designed for future floods/heat (elevations, drainage, cooling materials). Each ministry can set up a Climate Adaptation Unit to champion action, while budgeting must add climate lenses with dedicated funding for priority projects, treating adaptation as core to sustainable growth, not an add-on.

3. **Fast-tracking High-Impact Measures through Joint Efforts:** Fast-track, high-impact, low-cost measures like early warning systems, Nature-based Solutions, and community preparedness through joint action. A national EWS upgrade – linking meteorology, water, civil defense, health, and media/telecom – can deliver timely flood and heatwave alerts to all communities, ensuring effective, coordinated climate risk response.

4. **Protecting Vulnerable Groups via Multi-Sector Initiatives:** Protecting vulnerable groups requires multi-sector action. Schoolchildren, the poor, farmers, and elderly face the worst flood and heat risks. Ministries must jointly climate-proof schools, clinics, and infrastructure, enforce heat-health and labor protections, expand cooling and shaded spaces, and support farmers with resilient crops, irrigation, and insurance. Task forces (e.g., Resilient Schools, Heat Health) should coordinate cross-sector programs, reporting to the national climate council.

5. **Mobilize Sustainable Adaptation Financing Together:** Mobilize sustainable adaptation finance through a coordinated national plan. The Finance and International Cooperation department can lead with Environment and Planning to access global climate funds, MDB loans, and green finance. A National Adaptation Fund, public-private partnerships (PPPs), and climate budget tagging can align efforts, attract larger funding, and support insurance solutions – ensuring steady, strategic financing for resilience through 2050.

In conclusion, **Egypt stands at a critical juncture** in its climate resilience journey. The ERA project has provided a data-driven blueprint of what is at risk and which adaptation investments yield the highest payoffs. The next step is translating this evidence into policy and action – and doing so in a unified, strategic manner. With an initiative-taking, coordinated adaptation strategy, Egypt can turn climate risk into an opportunity, to build a more resilient nation that continues to thrive even in the face of climate adversity. **Investing in adaptation today is an investment in Egypt's sustainable future**, ensuring that development gains are protected and prosperity can endure for generations to come.

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For more information, please refer to the final report for Egypt.

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