Policy brief 21

WISER
Weather and Climate Information Services for Africa

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Calculating the cost of climate disasters: why investments in climate information services pay off

A new framework developed by the African Climate Policy Centre provides governments with a vital tool for calculating – and minimizing – the costs of climate disasters.

KEY POINTS

If governments are to invest in climate information services (CIS) to minimise the costs of climate disasters, they need to know – in very precise monetary terms – the returns on their investment.

A new framework demonstrates how modest investments in CIS can enable disaster interventions, leading to significant avoided costs and added benefits in many socio-economic sectors.

For governments, the framework is a vital tool for preparing disaster risk reduction strategies or expanding existing national and sectoral policies and strategies.

Since the 1980's, sub-Saharan Africa has experienced more than 1,000 climate-related disasters[1] . These have cost millions of lives, threatened food security and undermined development gains. The economic impact has been catastrophic: across developing nations, from the mid-1980s to 2000, climate damage has racked up a staggering US$130 billion in costs, wiping an estimated 10-14 % off these nations' GDP.

Climate Information Services (CIS) such as early warning systems anticipate extreme weather events. With accurate, long lead (3-6 months ahead) information about when floods, storms or landslides might hit, governments can plan accordingly by taking measures to minimise the social and economic damage that devastate local

1 Centre for Research on the Epidemiology of Disasters (CRED), Emergency Events Database (EM-DAT) (2004): link of web page: www.cred.be, (see 2004 statistics).

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populations. As well as tracking hydro-meteorological hazards ahead of time, CIS can map out patterns of hydro-meteorological disasters. Over time, these patterns can build up an evidence base for informed, longer term planning. They can guide decision makers on how and where to invest to improve their countries' climate resilience.

Evidence-based, investments in CIS can strengthen policymaking, helping communities to minimize the costs of potential damaged infrastructure, including housing, government buildings and road networks. Business assets can be protected; rural households can take measures to prevent damage to their homes; relief and restoration costs can be minimized. With the right information, planners can make optimal use of limited resources to protect climate-vulnerable areas, helping to ensure the uninterrupted delivery of vital amenities, such as water, sanitation, health, energy and education.

In the context of disaster risk management, the potential for minimizing costs and adding benefits by investing in CIS is clear: conservative estimates suggest that upgrading hydrometeorological information production and early-warning capacity in developing countries could save an average of 23,000 lives annually and generate between $3 billion and $30 billion per year in economic benefits[2] .

However, for policymakers to agree to allocate limited budgetary resources to improve the generation, dissemination and use of CIS, they need to know – in precise monetary terms – the potential social and economic returns on that investment.

New framework addresses cost-benefit data gaps

Previously, there had been only limited available data demonstrating the tangible benefits of investing in CIS. The new framework developed by the African Climate Policy Centre under the Weather and Climate Information Services for Africa (WISER) programme enables stakeholders to assess the socioeconomic benefits of using CIS in planning and development activities. A systems dynamics model, developed under the framework, allows stakeholders to run

2 Stéphane Hallegatte, "A cost-effective solution to reduce disaster losses in developing countries: hydro-meteorological services, early warning, and evacuation", Policy Research Working Paper, No. 6058 (Washington, D.C., World Bank, 2012).

Framework definitions:

(a) **Investment:** : in the private sector, this refers to the monetary costs of implementing a policy decision, such as complying with sustainability standards. In the public sector, this refers to the allocation or reallocation of financial resources with the aim of achieving a stated policy target, including the creation of enabling conditions for the development of sustainable businesses.

(b) **Avoided costs:** these refer to the potential costs that could be avoided as a result of the successful implementation of an investment or policy decision. They also include indirect avoided costs, including those related to health care, and the provision of key ecosystem services. For example, timely information can be used to provide advance warning of droughts, allowing communities to plan accordingly, either by delaying the planting season or by planting shorter-season seed varieties. This can avoid costs, including those associated with wasted labour and seed stocks. At the same time, governments can procure essential grain supplies long before the onset of droughts at much lower prices than they would pay during periods of acute food insecurity.

(c) **Added benefits:** : these refer to the monetary evaluation of economic, social and environmental benefits deriving from investment and policy implementation, and include short-, medium- and long-term positive impacts across sectors and actors. These added benefits are not accrued in business-as-usual scenarios. For example, effective CIS can predict well in advance when excessive rains are likely. With that information, water management authorities can open dam flood gates and take other mitigating steps before any floods occur. Anticipating excessive rains can allow policymakers to make better informed decisions on the medicines to procure for treating malaria or diarrhoea diseases, and to make logistical arrangements for distributing medicine. Similarly, accurate predictions of impending droughts can enable relevant stakeholders to reduce livestock populations and take measures to prevent land degradation.

a range of climate scenarios. Information generated can be used to estimate the social and economic benefits resulting from different levels of investment in CIS.

Well-targeted investments in CIS can improve the provision of accurate data on variables, such as temperature, rainfall, wind, soil moisture and ocean conditions. This information can increase the accuracy of climate forecasts and [modelling of] climate change scenarios, which, in turn enables stakeholders to make better-informed decisions on climate-related actions.

Climate change scenarios in the framework study examine the **avoided costs** and the **added benefits** that can be generated through investments in CIS. When costs are avoided, the financial resources saved can be used for other productive purposes – for example, if a drought is anticipated, livestock can be sold off and the money generated can be reinvested once the drought has ended. Over time, the costs and benefits can be compared with the costs of investments to improve CIS and indicate a significant return.

Investing in CIS to avoid the costs of climate disasters

The systems dynamics model analyses and compares four scenarios to assess the social and economic costs and benefits of investments in CIS. The scenarios are as follows:

1. "No-climate" scenario: it is assumed no climate impacts occur and no investments are made to improve CIS.
2. "Reference" scenario: although climate information may be available, it is not used to establish or enhance early-warning tools. Climate events are not anticipated, and

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communities suffer maximum climate-related damage (100 per cent).

3. "Business-as-usual" scenario: based on current funding levels for CIS in most sub-Saharan countries where investment allows only 30 per cent of CIS to be applied. This allows for a certain degree of disaster intervention and climate-related damage is reduced by 12 per cent, namely 100 per cent to 88 per cent.
4. "CIS investment" scenario: investments in human resources and equipment are made to enable 100 per cent of CIS to be applied. Interventions to enhance climate disaster resilience increase. In turn, climate-related damage is reduced by 75 per cent.

Climate-related damage in the four scenarios considers the impact on populations, including the number of people missing or killed by a climate-related disaster, the impact of the disaster on agricultural land and livestock, and the impact of the disaster on infrastructure such as roads, property, power grids, and transport networks. Post-disaster reconstruction often requires significant capital investment so the impact of the disaster on financial resources is also assessed.

Outcomes: the case of Mauritius

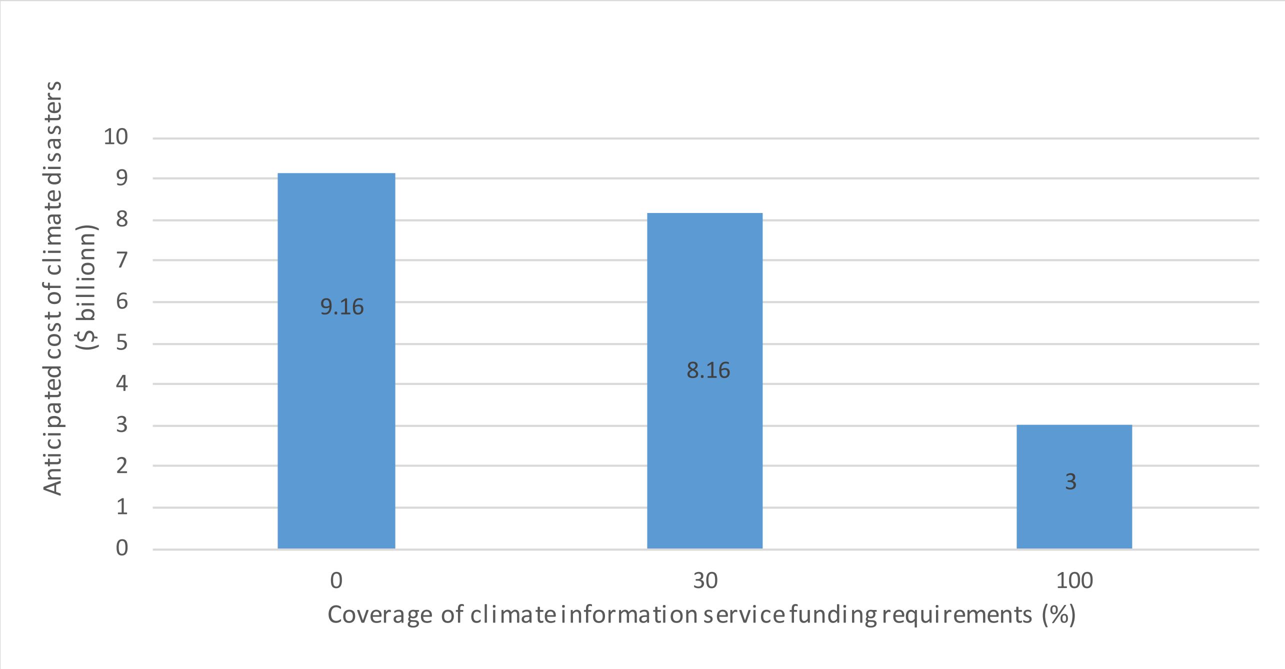
Anticipated avoided costs and added benefits from CIS investment

Table 1 and the figure illustrate the expected avoided costs and added benefits stemming from investments in CIS, as calculated when the framework was customized for Mauritius over a 30-year period (2020–2050).

Key findings were as follows:

- **Avoided costs**: in the "reference" scenario, damage caused by weather events is estimated at $9.16 billion; in the "business-as-usual" scenario, climate-related damage is reduced to $8.16 billion; in the "CIS investment" scenario, damage drops significantly to $3 billion. In all scenarios, most financial losses stem from loss of assets, including sown areas, equipment and buildings.
- **Added benefits**: in the "no-climate" and "reference" scenarios, there are no socioeconomic benefits. In the "business-as-usual" scenario, an investment of approximately $210 million would

Figure : Correlation between level of capacity and application of CIS and reduction of costs of climate disasters



Source: Garanganga and Pellaske (forthcoming).

Table 1: Avoided costs and added benefits of investment in different levels of CIS coverage

Scenario	Total climate costs ($ million)	Total socio-economic benefits ($ million)	Total investment ($ million)	Cost to benefit ratio ($ million)
Reference (coverage of 0% of climate information service funding requirements)	9,160.55			
Business-as-usual (coverage of 30% of climate information service funding requirements)	8,159.32	1,001.23	208.31	4.81
Adequate Climate information service investment (coverage of 100% of climate information service funding requirements by 2035)	3,027.19	6,133.36	8,45.14	7.26

generate socioeconomic benefits worth approximately $1 billion. In the "CIS investment" scenario, an investment of $845 million would increase socioeconomic benefits dramatically, reaching approximately $6 billion.

Investing in CIS: avoided costs by sector

As illustrated in table 2, when investments are increased from the assumed average of 30 per cent to 100 per cent, the expected avoided costs of adverse weather by sector are as follows::

- Damage to roads falls by almost two thirds, from approximately $410 million to just over $166 million
- Health-care costs decline by almost two thirds, from approximately $83 million to less than $32 million

Table 2: Costs of adverse weather by scenario and sector

	Reference ($ million)	Business-as-usual ($ million)	% of Reference	CIS investment ($ million)	% of Reference
Roads	465.6	410.3	-11.88%	166.1	-64.33%
Health care	94.8	83.4	-11.98%	31.7	-66.58%
Total agriculture	54.8	49.8	-9.05%	22.3	-59.21%
Livestock	5.3	4.7	-11.45%	2.2	-58.91%
Agriculture production	49.5	45.2	-8.79%	20.2	-59.25%
Financial capital	8,545.3	7,615.8	-10.88%	2,807.1	-67.15%
Total	**9,160.5**	**8,159.3**	**-10.93%**	**3,027.2**	**-66.95%**

Source: Garanganga and Pellaske (forthcoming).

- Agricultural production costs are reduced by more than 50 per cent from more than $45 million to slightly more than $20 million; livestock losses also drop significantly, from $4.7 million to $2.2 million

Marginal increases in CIS investment funding generate significant returns on investment

As stated above, the socioeconomic benefits model predicts that an investment of approximately $210 million, equivalent to less than 0.1 per cent of the country's projected GDP by 2050, would enable Mauritius to avoid damages and generate additional benefits that together would be worth approximately $1 billion, and that an investment of $845 million would enable Mauritius to avoid damages and generate additional benefits equivalent to approximately $5 billion, starting from a business-as-usual scenario of 30 per cent, approximately $a billion against $6.133 billion for 100 per cent CIS coverage . These figures indicate that investments pay back at least four times in avoided damage and added benefits. A comparison of the expected value of avoided damage and added benefits in key sectors under the various scenarios is shown in table 3.

Table 3: Comparison of the expected value of avoided damages and added benefits in key sectors under the various scenarios

Sector	Avoided damage and added benefits (business-as-usual scenario compared with reference scenario) ($ million)	Avoided damage and added benefits (CIS investment scenario compared with business as usual scenario) ($ million)	Avoided damage and added benefits (climate information service investment scenario compared with reference scenario) ($ million)
Roads	55.3	244.2	299.5
Health care	11.4	51.8	63.1
Total agriculture	5.0	27.5	32.4
Livestock	0.6	2.5	3.1
Agriculture production	4.4	25.0	29.3
Capital	929.6	4,808.7	5,738.3
Total	**1,001.2**	**5,132.1**	**6,133.4**

The case for increasing investments in national meteorological and hydrological services

National meteorological and hydrological services are a small but important part of the public sector, with budgets of between 0.01 and 0.05 per cent of GDP. Numerous studies have shown that investing in those services can generate significant positive socioeconomic returns, with cost-benefit ratios of between 1 to 4 and 1 to 6. Investment in CIS can bolster the capacity of national meteorological and hydrological services to mitigate the impact of hydrometeorological disasters. Social and economic benefits of robust CIS far outweigh the costs of investing in CIS; equally the cost of investing in CIS are minimal compared with the significant costs incurred if countries do not invest sufficiently.

Conclusion

Modest investments in CIS can result in significant avoided costs and added benefits. The new framework is a vital tool that can help governments formulate and strengthen national and sectoral disaster risk reduction strategies. The framework will prove particularly useful for countries whose economies are increasingly exposed to climate change-related hydrometeorological risks.

Climate information services outreach and capacity development programmes should be implemented across countries in sub-Saharan Africa to facilitate their efforts to adapt to and mitigate the impact of climate change and increasing climate variability.

National meteorological and hydrological services, regional climate centres and other relevant stakeholders that are working in such areas as disaster risk reduction, agriculture, water, energy and health must engage with economic, planning and finance ministries with a view to enhancing the role of CIS. The formulation of appropriate CIS policies will, in turn, ensure that countries in sub-Saharan Africa can adopt cost-effective adaptation measures to deal with climate variability and climate change and reduce the risks caused by climate hazards before they become disasters.

Policy recommendations

The following recommendations are made to policymakers:

1. Establish baselines and metrics – such as on expected disaster fatalities and economic losses – that can be used to measure the effectiveness of existing disaster risk reduction policies. Those baselines and metrics can be set, for example by identifying the percentage of the population living or working in buildings in high-hazard zones with a moderate or high susceptibility to collapse: this will require the mapping of vulnerable areas, and risk levels at subregional and national levels.

2. Set measurable and clearly defined indicators, including, for example, the number of people in an area who are covered by an effective action plan. Indicators must be precise and simple to calculate, to facilitate their adoption by countries.

3. Establish a transparent and rigourous methodology for calculating and compiling indicators. Guidelines explaining the use of that methodology should be formulated to provide countries with support. Those guidelines should be flexible to take into account the capacities and resources available to different countries.

4. Establish effective data validation mechanisms to ensure the accuracy of the data collected and ensure the sustainability of data collection methods.

5. Establish and strengthen partnerships with academia and civil society to ensure that climate information products are well targeted and address priority needs.

6. Carry out pilot studies to ascertain the potential socioeconomic benefits that could result from investments in climate

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information services at subregional and national levels.

7. Conduct hands-on training sessions to help National Meteorological and Hydrological Services and user communities to assess accurately the potential socioeconomic impact of reliable weather and climate forecasts. The training sessions should cover how assessments can enhance decision-making to enable relevant stakeholders to formulate appropriate policies and establish a community of practice on the economic utility of weather and climate forecasts in Africa.

About ACPC

The African Climate Policy Centre (ACPC) is a hub for demand-led knowledge on climate change in Africa. It addresses the need for greatly improved climate information for Africa and strengthening the use of such information for decision making, by improving analytical capacity, knowledge management and dissemination activities.

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