POLICY BRIEF

Calculating the cost of climate disasters – and 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 minimising – 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 populations. As well as tracking hydro-meteorological hazards

[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).

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.

Well-informed investments in CIS can enable better informed policy, helping communities to avoid the costs of damage to infrastructure such as 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 minimised. With the right information, planners can invest resources to protect climate vulnerable areas, helping to ensure uninterrupted delivery of vital services such as water, sanitation, health, energy and education.

In the context of disaster risk, the potential cost savings and added benefits of improving CIS are clear: conservative estimates suggest that upgrading all hydrometeorological information production and early-warning capacity in developing countries would save an average of 23,000 lives annually and provide between US$3 billion and US$30 billion per year in additional economic benefits related to disaster reduction[2].

But if policymakers are to commit national budget to improve the generation, dissemination and application of these services, they need to know – in very precise monetary terms – the social and economic returns of their investment.

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[2] A Cost-Effective Solution to Reduce Disaster Losses in Developing Countries: Hydro-Meteorological Services, Early Warning, and Evacuation, Stéphane Hallegatte, 2012

Framework definitions:

a) ***Investment****:* from a private sector perspective, investments refer to the monetary costs of implementing a decision, such as complying with sustainability standards. From a public-sector point of view, investments refer to the allocation and/or reallocation of financial resources with the aim of reaching a stated policy target (e.g. create enabling conditions for the development of sustainable businesses in a given country).

b) ***Avoided costs****:* the estimation of potential costs that could be avoided as a result of the successful implementation of an investment/policy. This also includes indirect avoided costs, e.g. health expenditure, avoided losses from environmental degradation, and avoided payments for the replacement of key ecosystem services (UNEP, 2012a).
For example, with optimum CIS, droughts can be anticipated well ahead of their occurrence. With timely information, communities can plant shorter season seed varieties; longer season varieties would not reach maturity due to deficient rains. Or, indeed, they may decide not to plant at all depending on the severity of the foreseen drought. This would **avoid costs** in terms of labour, seeds, productivity, etc. At the same time, grain can be procured/imported long before the drought at much lower prices than if governments import grain when there is imminent strain on food provision.

c) ***Added benefits:*** the monetary evaluation of economic, social and environmental benefits deriving from investment/policy implementation, focusing on short-, medium- and long-term impacts across sectors and actors. These are **added benefits** that would not be accrued in a business as usual scenario. For example, with optimum CIS, excessive rain can be anticipated well ahead of its occurrence. With this information, water authorities can open flood gates of dams and have water utilised downstream before floods threaten. Also destocking due to forecast drought can lead to various added benefits relating to the protection of environment from land degradation. Anticipated excessive rains can better inform decision on what medicines to procure - or not - for malaria or diarrhoeal diseases. In addition, the best logistical arrangements for procurements and distribution can be made.

New framework fills cost-benefit evidence gap

In the past, there has been limited evidence available that demonstrates the tangible benefits of investing in CIS.

Now, the African Climate Policy Centre (ACPC) of the United Nations Economic Commission for Africa (UNECA) under the Weather and Climate Information Services for Africa (WISER) programme has elaborated a framework that can accurately assess the socio-economic benefits (SEBs) of using CIS in planning and development activities. A systems dynamics model, developed under the framework, allows for the running of different scenarios which helps estimate the SEBs from different level investments in CIS.

Investments can improve climate forecasts and climate change scenarios by making available the best possible climate data and information – on temperature, rainfall, wind, soil moisture and ocean conditions – in a timely manner. This enables better weather forecasts, early warning systems and seasonal climate forecasting. In turn, this leads to better-informed action and improved decision making, leading to significant returns on investments.

These scenarios examine the **avoided costs** and the **added benefits** that can be generated through investments in CIS. When costs are avoided, the money 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 reinvested at a later date once the drought has lifted, thus putting funds to more effective use. Over time, the costs and benefits can be compared with the costs of investments to improve CIS.

The correlation between investments in climate information and damaged caused by climate disasters

The SEB model analyses and compares four scenarios to order to assess the cost-benefits of investments to improve climate information. The four scenarios are as follows:

1. It is assumed there are no climate impacts and no investments to improve the coverage of CIS. This is recognised as the ‘no-climate’ scenario.
2. While climate information may be available, no information is factored in for use in early warning tools. Climate events are not anticipated, and maximum damaged (100%) is caused. This is recognised as the ‘reference’ scenario”.
3. Current investments are made to enable only 30% of CIS to be applied. This is assumed to be the current level of coverage of CIS in most sub-Saharan countries. 30% coverage allows for a certain degree of disaster intervention and climate damages are reduced from 100% down to 88%. This is recognised as the ‘business-as-usual’ scenario”.
4. Investments are made in human resources (producers and users of CIS) and in equipment for gathering and processing data to enable 100% of CIS to be applied. Disaster interventions to build resilience increase dramatically and climate damages are reduced to 25%. It is not possible to fully eliminate damages caused by extremes in climate, so a future 75% reduction in damages is deemed to be feasible. With advances in climate science and technology higher reduction will be achievable. This is recognised as the “CIS scenario”.

The impacts of these scenarios are considered in terms of numbers of population (e.g. numbers of people affected, missing dead), agricultural land and livestock affected, impacts on infrastructure such as roads, real estate, power distribution, and mobility. The impact on capital stocks are also assessed since replacement or rebuilding after disasters requires additional capital investment.

Results: the case of Mauritius

Comparing investments in CIS with avoided costs and added benefits

The following tables illustrate the avoided costs and added benefits of the total investment in CIS when the framework was customised for Mauritius over a 30-year period (2020-2050).

Top line findings were as follows:

- **Avoided costs:** When there are no investments in climate information, **0%** of climate information is used. In this case, climate events are not anticipated, and damage caused by weather events sits at **$9.16bn**; where investments allow **30%** of climate information to be applied, damage is reduced to **$8.16 bn**; when investments enable **100%** of climate information to be applied, damages drop significantly to **$3bn**. In all scenarios, the largest portion of damages stem from the loss of capital, such as sown area, equipment, buildings, and other productive assets.
- **Added benefits:** When there are no investments in climate information, there are no socio-economic benefits. Investing **$210m** achieves 30% coverage (the “business-as-usual” scenario) resulting in **$1bn** of socio-economic benefits. When this investment is increased marginally to **$845m**, to achieve 100% CIS coverage the socio-economic benefits increase dramatically – reaching **$6bn**.

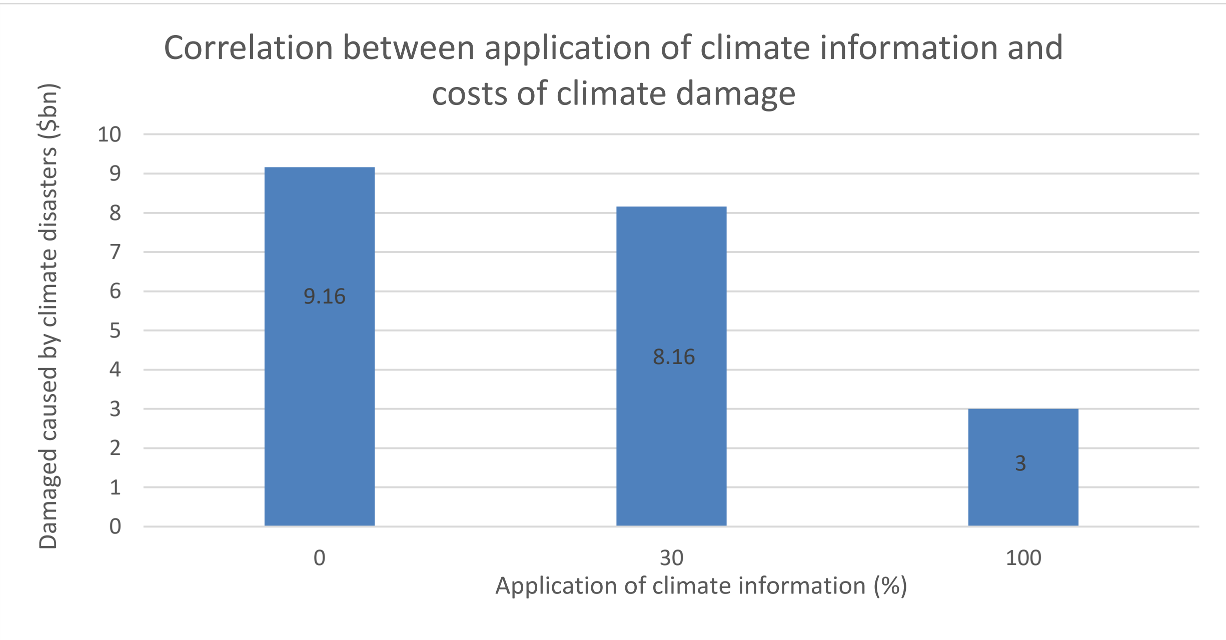

Fig 4.1: Correlation between application of climate information and costs of climate damage

Scenario	**Total impacts** (million USD)	**Total SEBs** (million USD)	**Total investment** (million USD)	**Cost to benefit ratio**
Reference (0% CIS coverage)				
Full climate impacts	9'160.55	-	-	-
BAU (30% CIS coverage)				
Impacts climate	8'159.32	1'001.23	208.31	4.81
CIS investment (100% coverage by 2035)				
CIS investment	3'027.19	6'133.36	845.14	7.26

Table 4.1: Avoided costs and added benefits of the total investment in CIS

Investing in CIS: avoided costs by sector

When investments are made to increase climate information to 100% from the assumed average of 30% the **avoided costs** of adverse weather by sectors are as follows:

- damage to roads drops by almost a third from $410m to $166m
- climate impacts on healthcare also drops by almost a third from $83m to $32m
- costs to production of agriculture to livestock are reduced by over half from $42m to $20m; livestock losses are reduced significantly from $4.7m to $2.2m

	Costs of adverse weather by scenario and sector				
Sector	**Reference** (million USD)	**BAU** (million USD)	% of Reference	**CIS investment** (million USD)	% 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%*
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%**

Table 4.2: **Costs of adverse weather by scenario and sector**

Marginal increases in CIS investment reap major benefits

As referenced above, a key finding shows that an investment of $211m (0.1% of GDP) yields $1bn in benefits; when this investment is quadrupled to $854m, benefits increase to $5bn.

Sector	**BAU to Reference** (million USD)	**Added benefits CIS investment** (million USD)	**Total SEBs** (million USD)	**Total investment (in BAU)** (million USD)
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*	211.3
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**	**211.3**

Table 4.3: Showing BAU reference, added benefits by sector against CIS investment, total of SEBs and total investment in BAU.

These figures indicate that investments pay back more than **four times** in avoided damages and added benefits. This $5bn in added benefits are recognised in monetary terms across various sectors; the breakdown of benefits generated by CIS investment by sector are shown in the table below:

Sector	**Added benefits CIS investment** (million USD)
Roads	244.2
Health Care	51.8
Total agriculture	27.5
Livestock	*2.5*

Agriculture production	*25.0*
Capital	4'808.7
Total	**5'132.1**

Table 4.4: Showing added benefits by sector against CIS investment.

The case for increasing investments in NMHSs

National Meteorological and Hydrological Services (NMHSs) are a small but important public sector - with budgets of usually about 0.01–0.05 % of national GDP (Hallegatte, 2012). Consistent with the current study of SEBs in CIS for DRR findings, assessments elsewhere show high economic returns from better NMHSs—with cost-benefit ratios of 1:4 - 1:6 (Tsirkunov et al. 2007). Investment in CIS can increase NMHSs capacity to reduce disasters that are triggered by hydrometeorological hazards. 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

The WISER framework demonstrates that modest investments in CIS can enable disaster interventions, leading to significant avoided costs and added benefits in many socio-economic sectors. By assessing the socio-economic benefits of CIS, the WISER framework becomes a vital tool to help governments prepare their disaster risk reduction strategies or to expand existing national and sectoral policy and strategies. Such a tool is crucial for countries whose economies are increasingly exposed to hydrometeorological risks as the impacts of climate change deepen.

The findings of the framework study highlight the need for outreach programmes and capacity development on CIS across countries in sub-Saharan Africa. This will lead to efficient, cost-effective policies that help countries adapt to climate variability and climate change risks.

In the first instance, National Meteorological and Hydrological Services (NMHSs), Regional Climate Centres (RCCs) and socio-economic sectors such as DRR, agriculture, water, energy and health will need the capacity to develop joint strategies to engage respective economic, planning and finance ministries to make the necessary investments required for optimum CIS. The formulation of appropriate policies in CIS will in turn ensure that sub-Saharan Africa has concrete, cost-effective adaptation to climate variability and climate change and reduce the risks caused by climate hazards before they can become disasters.

Policy recommendations

The study clearly demonstrates the need for polices that invest in CIS in order to avoid major costs resulting from climate-related disasters while generating socio-economic benefits. The following recommendations are put to policy makers to make appropriate levels of investment in CIS in order to maximise the return of that investment in relation to socio-economic benefits that will accrue:

1. Set baselines and metrics – such as on expected disaster fatalities and economic losses – that can measure the effectiveness of DRR policies put in place. These metrics can be set, for example by identifying the percentage of the population living or working in buildings with moderate and high susceptibility to collapse in high-hazard zones: this includes mapping of vulnerable areas, exposure and risks at sub-regional and national level.
2. Set measurable and clearly-defined indicators (e.g. number of people in an area covered by an effective action plan). Indicators must be both precise and simple, so all countries can follow and adhere to the same global norms.
3. Establish a transparent and rigorous methodology to calculate and/or compile the indicators. Guidelines should explain how this methodology can calculate and test these indicators to help national and regional bodies compile this information. The guidelines must be adaptable to different situations in terms of resources and capabilities.
4. All efforts should be made to ensure the accuracy of the data collected and the sustainability of the collection procedures. Methods should be set to validate data with data from key at-risk communities being prioritised.
5. Establish and strengthen partnerships with academia and civil society to ensure that best possible climate information products are tailored and well-targeted.
6. Carry out pilot studies that examine the SEB on investing in CIS for DRR, and other sectors at sub-regional and national levels.
7. Once a model examining the SEB of investing in CIS has been validated, a series of hands-on training sessions on economic assessments of generating and applying optimum weather and climate forecasts should follow. The sessions should include how these assessments can be applied to decision making in different sectors in user communities, in partnership with Regional Climate Centres and National Meteorological and Hydrological Services. This will enable stakeholders to formulate appropriate policies for establishing a community of practice on economic utility of weather and climate forecasts in Africa.

WISER is supported by:

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