Modelling Social and Economic Benefits of Climate Information Services for Disaster Risk Reduction

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Bradwell J Garanganga,
Consultant
Email addresses: bjgaranganga@gmail.com ;
bjgaranganga@yahoo.co.uk
Mobile numbers+263-772-220330/-719-220330 and also Whats App accessible
Credits: G Pallaske

Format of Presentation

BACKGROUND

- Global Economic Cost of Natural Disasters
- Hydrometeorological Hazards

BRIEF OVERVIEW OF METHODOLOGY

- Rationale of SEBs
- System Dynamics Modelling

RESULTS

SUMMARY

WAY FORWARD

GLOBAL ECONOMIC COST OF DISASTERS

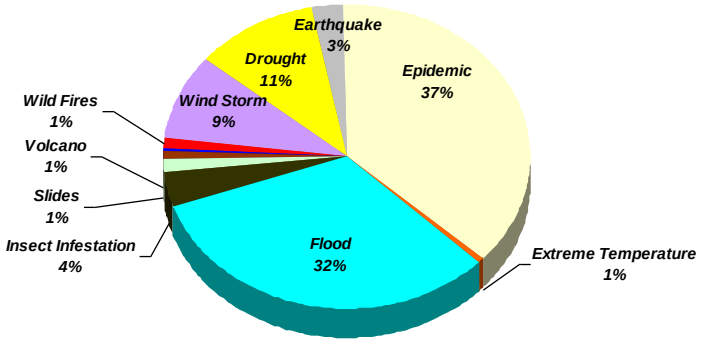
THE REPORTED GLOBAL COST OF NATURAL DISASTERS HAS RISEN SIGNIFICANTLY, WITH A 15-FOLD INCREASE BETWEEN THE 1950S AND 1990S.

DURING THE 1990S, MAJOR NATURAL CATASTROPHES ARE REPORTED TO HAVE RESULTED IN ECONOMIC LOSSES AVERAGING AN ESTIMATED US$66BN PER ANNUM (IN 2002 PRICES).

IT IS ALSO ESTIMATED THAT IN DEVELOPING NATIONS LOSSES ARE TYPICALLY 10-14 % OF GDP, ABRAMOVITZ, (2001)

Global Distribution of Disasters Caused by Natural Hazards and their Impacts in Africa(1980-2007)

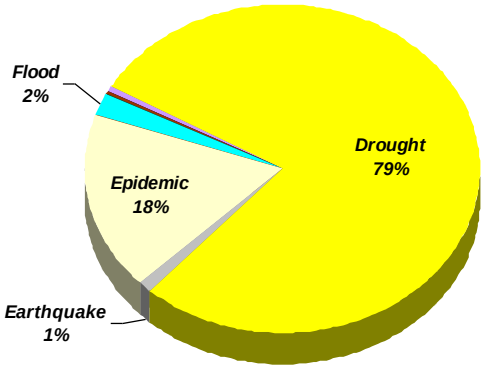
Number of disaster events - 1980-2007 (RA I)



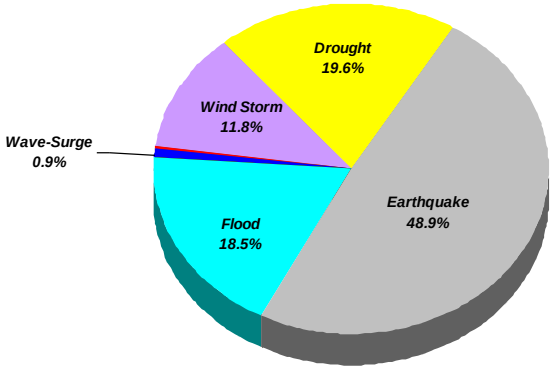
97% of events
99% of casualties
61% of economic losses

are related to hydro-meteorological hazards and conditions.

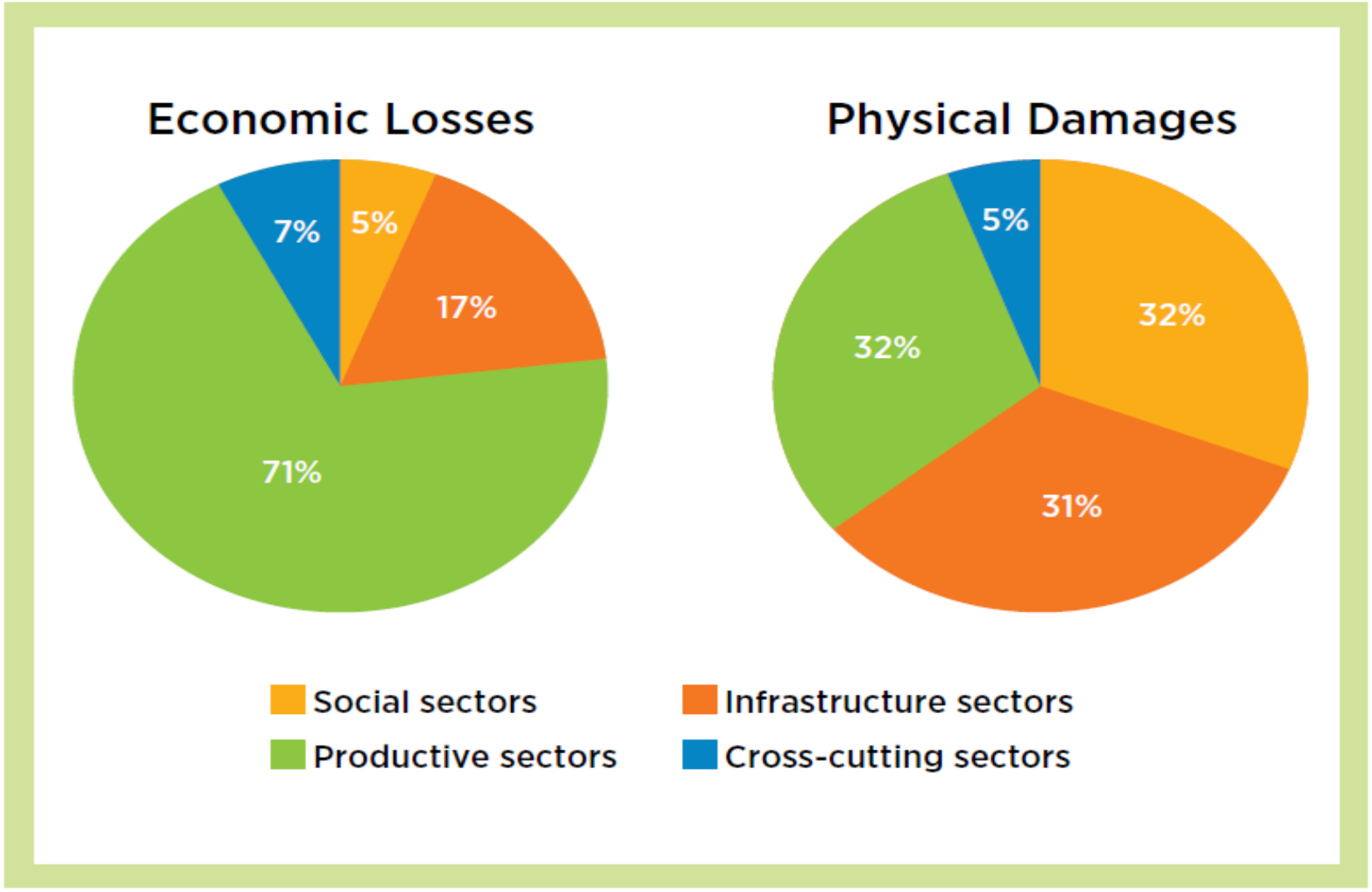
Casualties - 1980-2007 (RA I)

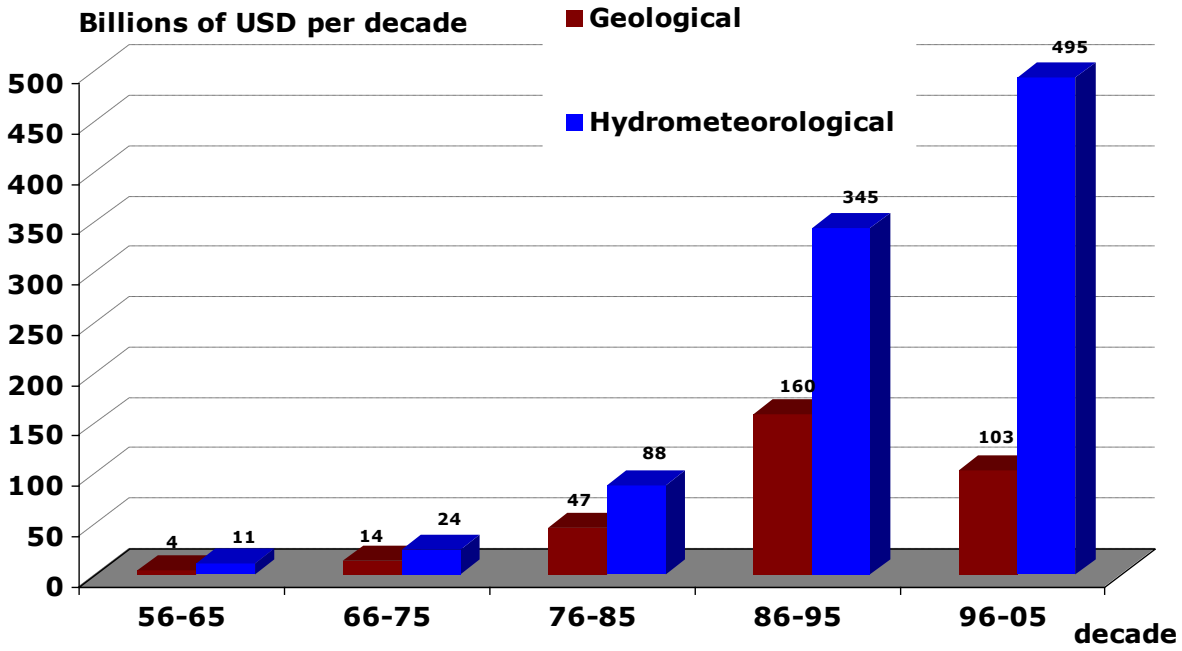


Economic losses - 1980-2007 (RA I)



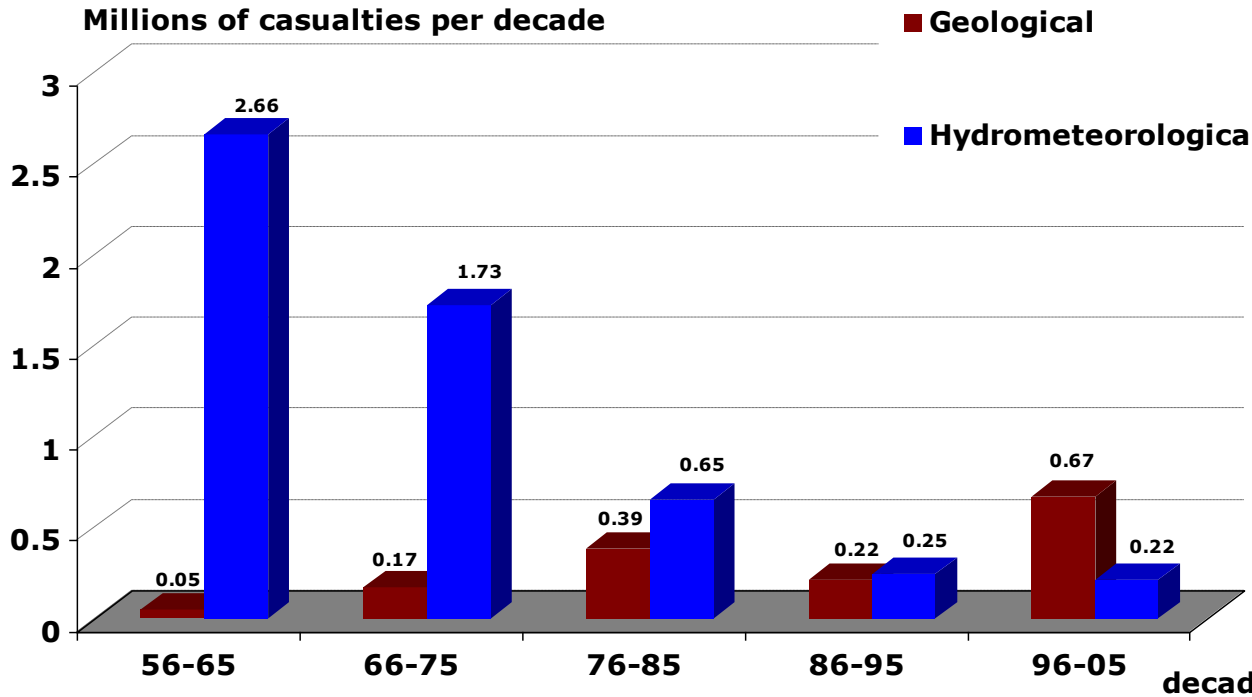
(a) Economic losses and (2) physical damages caused by hydrometeorological hazards (Adapted from ISDR: 2014)





Economic losses related to disasters are on the way up

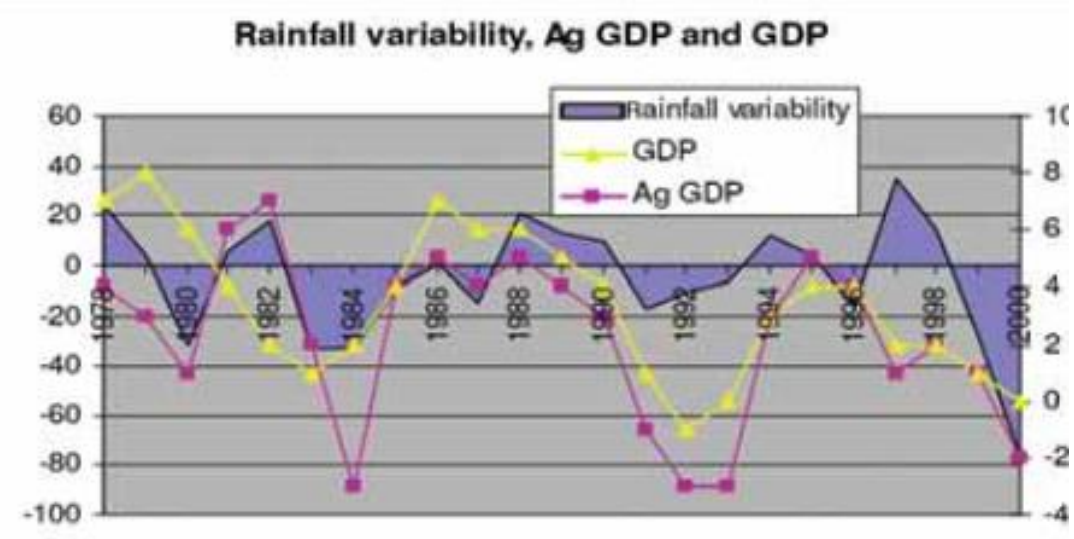
While casualties related to hydro-meteorological disasters are decreasing



Source: EM-DAT: The OFDA/CRED International Disaster Database

Historical trends in rainfall variability, agriculture GDP and total GDP of Kenya.

Source: UNESCO, 2006???????.



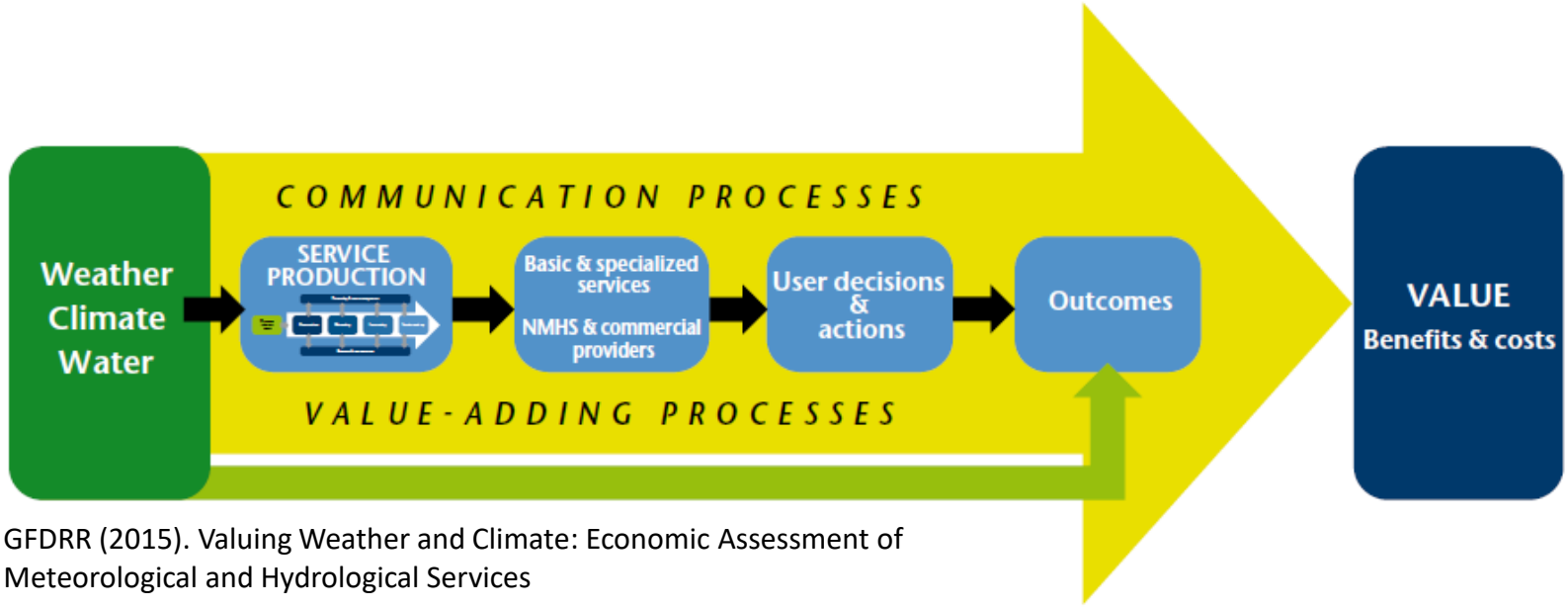
What needs to happen

- THE NEGATIVE IMPACTS OF HYDROMETEOROLOGICAL HAZARDS ON AGRICULTURE AND FOOD SECURITY, WATER RESOURCES OFTENTIMES LEAD TO DISASTERS. OVER 90% OF NATURAL DISASTERS IN AFRICA ARE A CONSECUTIVE CONSEQUENCE OF THESE HAZARDS.

- CLIMATE INFORMATION SERVICE (CIS) IS AN IMPORTANT COMPONENT OF THE EVIDENCE BASE REQUIRED TO GUIDE DECISIONS REGARDING APPROPRIATE LEVELS OF INVESTMENT TO MINIMIZE NEGATIVE POTENTIAL IMPACTS ON THE ECONOMY, ENSURING UNINTERRUPTED DELIVERY OF CRITICAL SERVICES AND INFRASTRUCTURE.

- INVESTING IN THE DEVELOPMENT OF EARLY WARNING SYSTEMS (CIS) AND CONTINGENCY PLANNING, IMPACTED SECTORS (SUCH AS AGRICULTURE) IS NECESSARY TO HELP PROTECT SOCIO-ECONOMIC WELFARE.

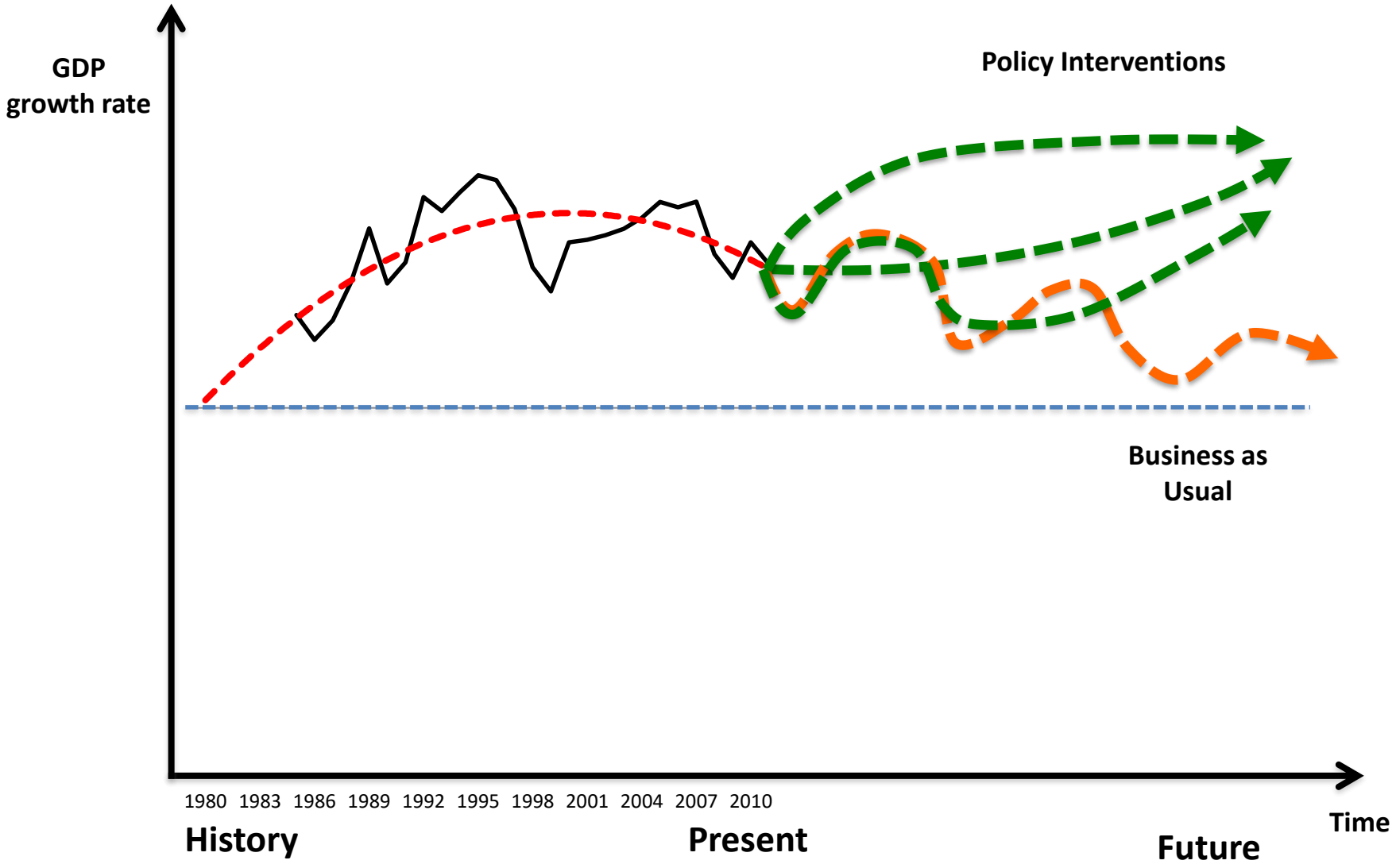
SEB planning processes



GFDRR (2015). Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services

- Policy makers need estimates on the likely impacts of policies and investments.
- This includes as assessment of the potential dissemination of -and access to- the information generated.
- If the benefits, for any given economic actor or economy-wide outweigh the cost, the investment is justified.

Rationale for SEB Analysis



Socio-Economic Benefits

The Socio-Economic Benefits of Climate Information Systems are many and varied.

- Some are direct (e.g. weather information, rainy days), some indirect (e.g. higher yield) some are induced (e.g. higher tax revenues).
- Some affect households (e.g. avoided damage to private property), others impact on businesses (e.g. avoided supply chain disruption) and the government (e.g. reduced infrastructure expenditure).

Socio-Economic Benefits: approach

Investments −

Avoided Costs +

- ✓ *Environmental*
  - *Remediation costs*
- ✓ *Social*
  - *Life and infrastructure losses*
- ✓ *Economic*
  - *Reduced water consumption (and cost)*

Added Benefits

- ✓ *Environmental*
  - *Ecosystem Services*
- ✓ *Social*
  - *Employment*
- ✓ *Economic*
  - *Income and GDP growth*

Socio-Economic Benefits: approach (2)

- Investments represent the cost of intervention, across various economic actors.
  - Include capital costs, which can be shared across economic actors through the use of incentives (provided by the government) and co-financing (provided by the private sector and households).
  - The estimation should also include operation and management costs (i.e. running costs) as well as the cost of financing.
  - Investments are expressed in monetary terms.

Methodologies and models

- Traditional assessments include:
  - **Regression analysis**: assesses the sensitivity to certain sectors/activities to climatic changes.
  - **Cost loss models**: compare the cost of protection to a probable climate-related loss. This approach can include social and environmental dimensions (Continuously Forecasting System).
  - **End-to-end forecasting**: links a biophysical model (e.g. crop yield) to an economic model (e.g. profit maximizing) to identify optimal adaptation strategies.
  - **System Dynamics**: focuses on causality, merges social, economic and environmental indicators to generate "what if" scenarios for policy analysis. It is a "knowledge integrator".

Data sources

National Gvts, United Nations Agencies.

For instance, UNISDR, the United Nations Office for Disaster Risk Reduction is promoting a global initiative to build

- national disaster databases with a well defined methodology.
- UNISDR uses for this purpose the DesInventar free, open source methodology and software.
- It permits the homogeneous capture, analysis

and graphic representation of information on disaster occurrence and loss.

- It has been under continuous development and improvement.

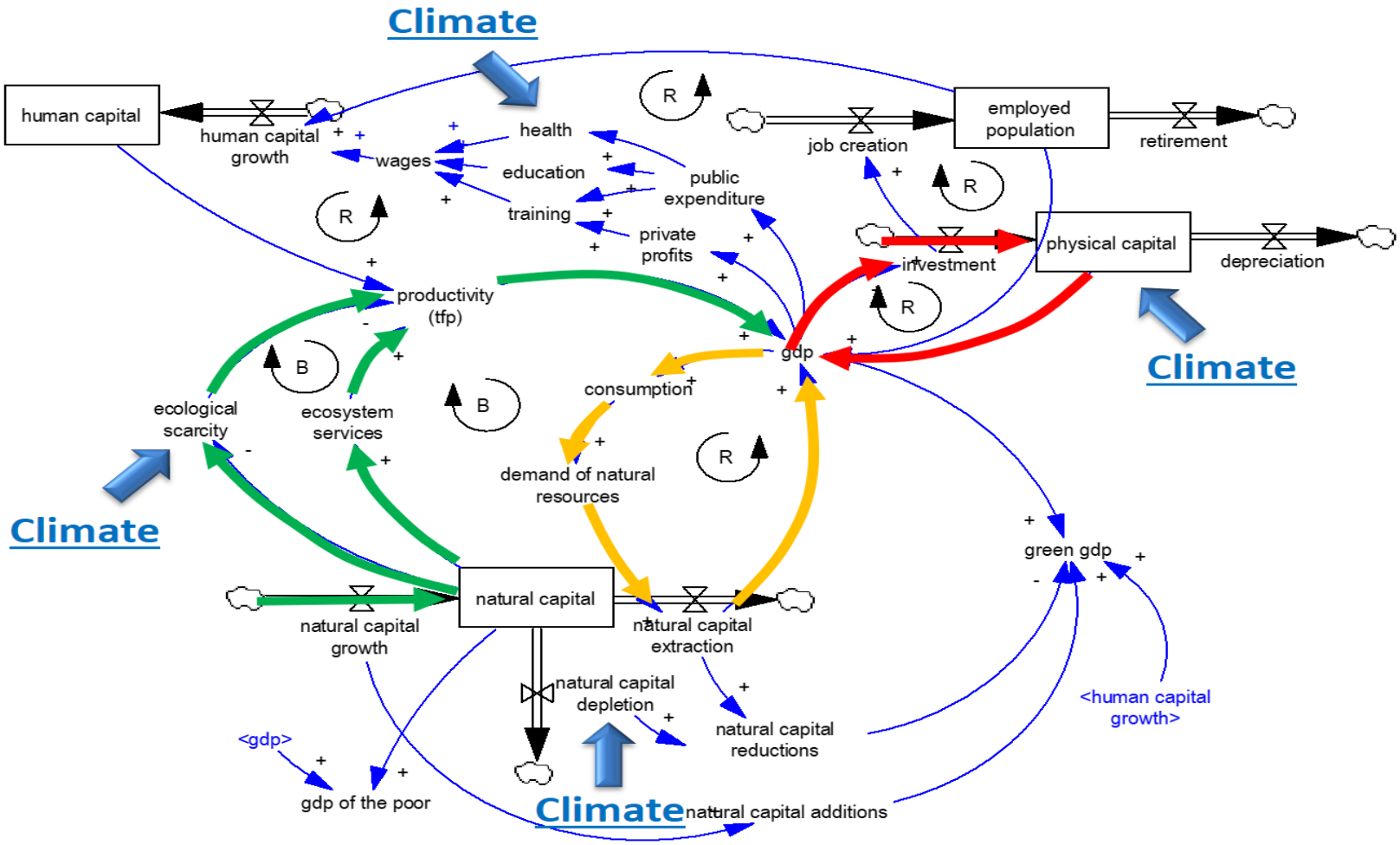
Disasters ranked according to (a) deaths and (b) economic losses (1970-2012).

(a)	Disaster Type	Year	Country	Number of Deaths
1	Drought	1983	Ethiopia	300000
2	Drought	1984	Sudan	150000
3	Drought	1975	Ethiopia	100000
4	Drought	1983	Mozambique	100000
5	Drought	1975	Somalia	19000
6	Flood	1997	Somalia	2311
7	Flood	2001	Algeria	921
8	Flood	2000	Mozambique	800
9	Flood	1995	Morocco	730
10	Flood	1994	Egypt	600

(b)	Disaster Type	Year	Country	Economic loss in USD Billions
1	Drought	1991	South Africa	1.69
2	Flood	1987	South Africa	1.55
3	Flood	2010	Madeira	1.42
4	Storm (Emille)	1977	Madagascar	1.33
5	Drought	2000	Morocco	1.20
6	Drought	1977	Senegal	1.14
7	Storm (Gervaise)	1975	Mauritius	0.85
8	Flood	2011	Algeria	0.79
9	Storm	1990	South Africa	0.69
10	Storm (Benedicte)	1981	Madagascar	0.63

Source-wmo 2014

Conceptual representation of the System Dynamics model



Structure In Use to Represent CIS Coverage in the CIS model

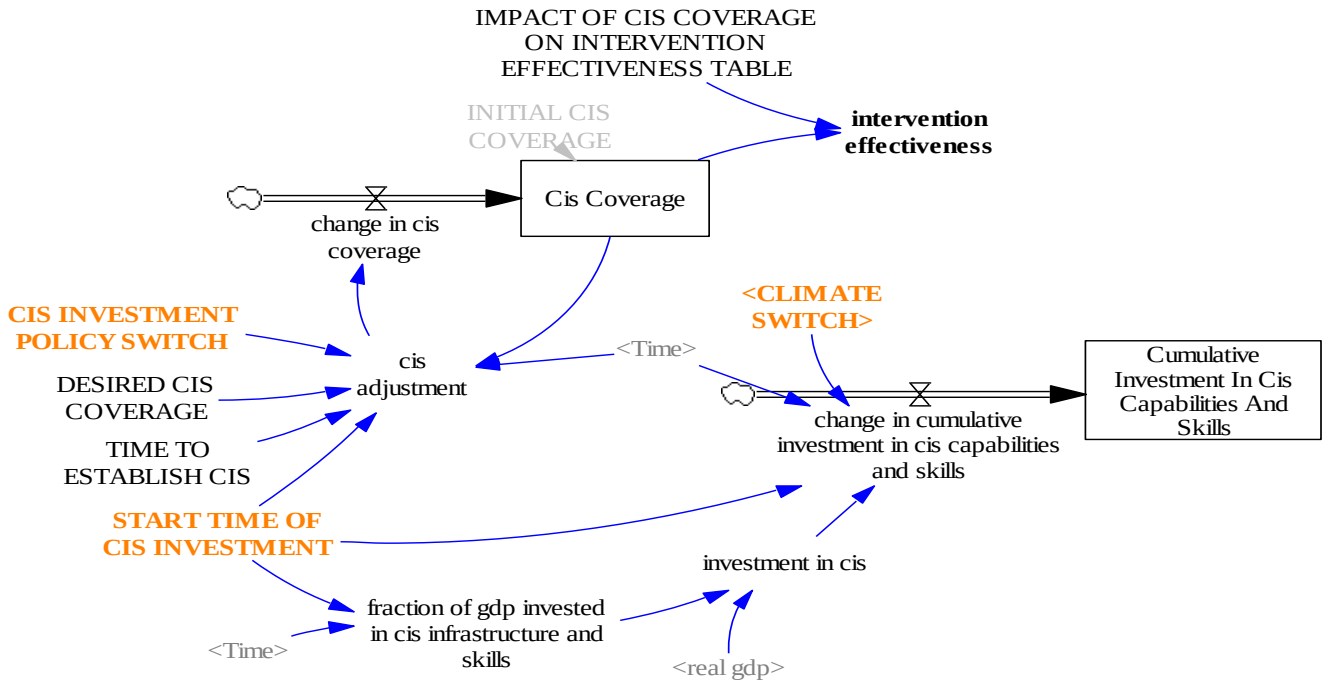


Figure 12.5: Structure in use to represent CIS coverage in the CIS SEB model

Real GDP in BAU Climate Scenario 1980 to 2015

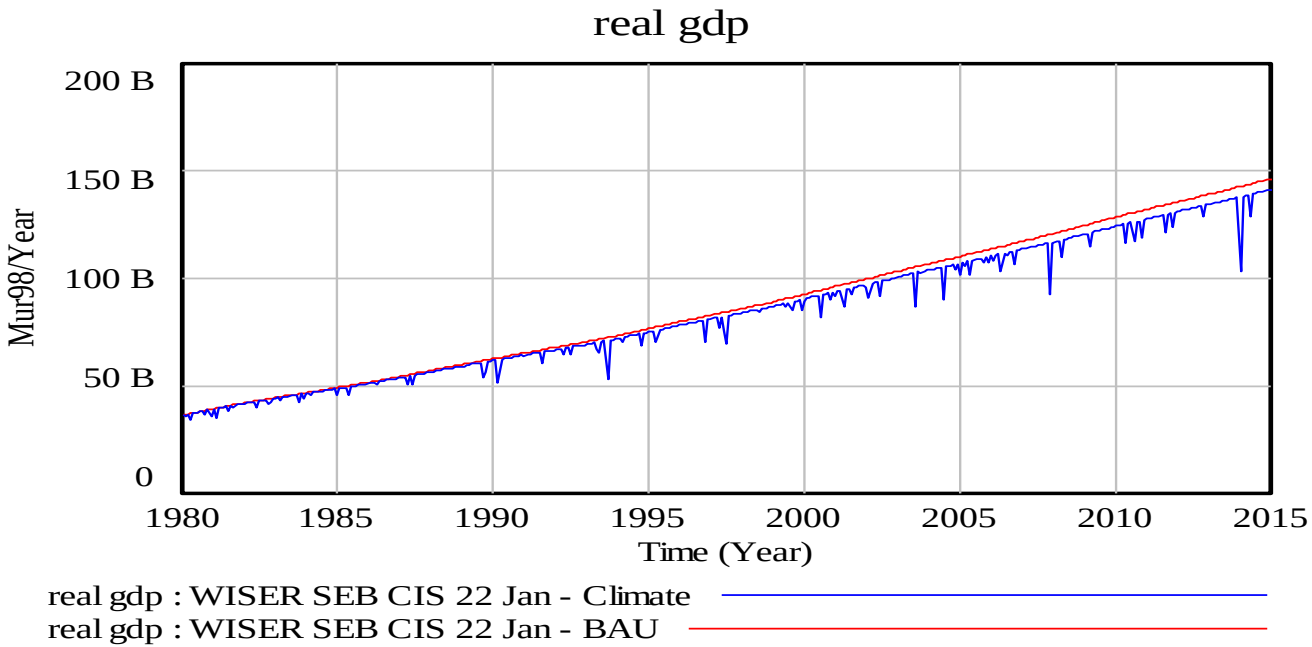


Table 11.9: Real GDP in BAU and Climate scenario 1980 to 2015

Total Affected Population

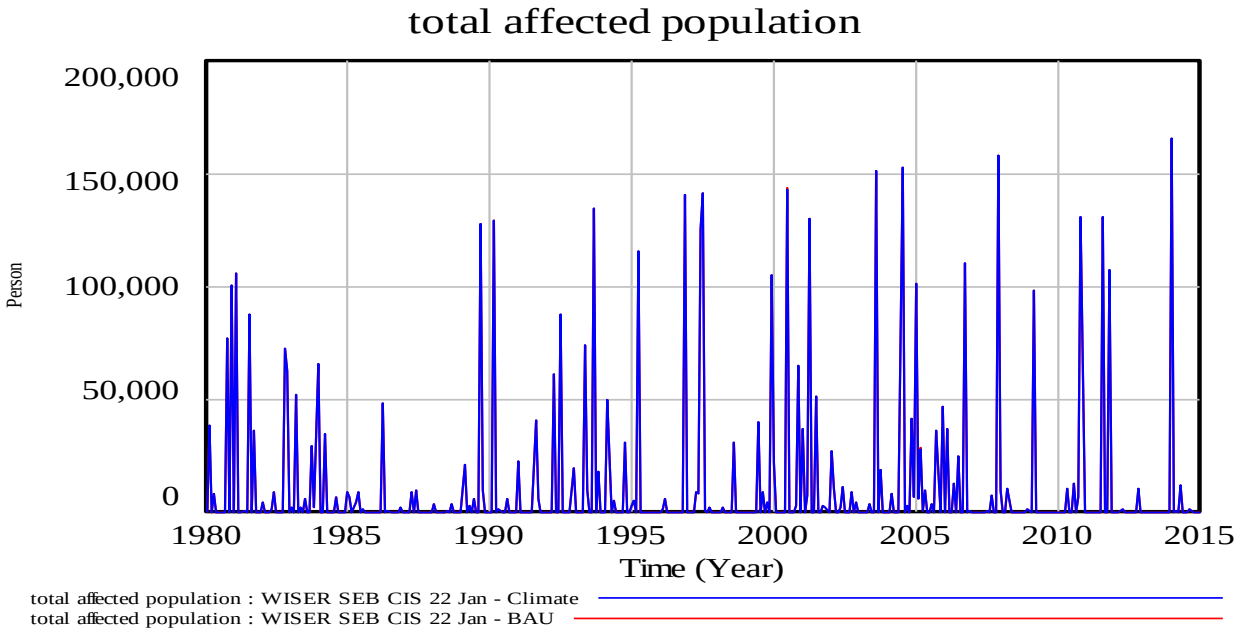


Figure 12. 16: Total affected population in the BAU and Climate scenario 1980 to 2015

Climate Impacts on Population

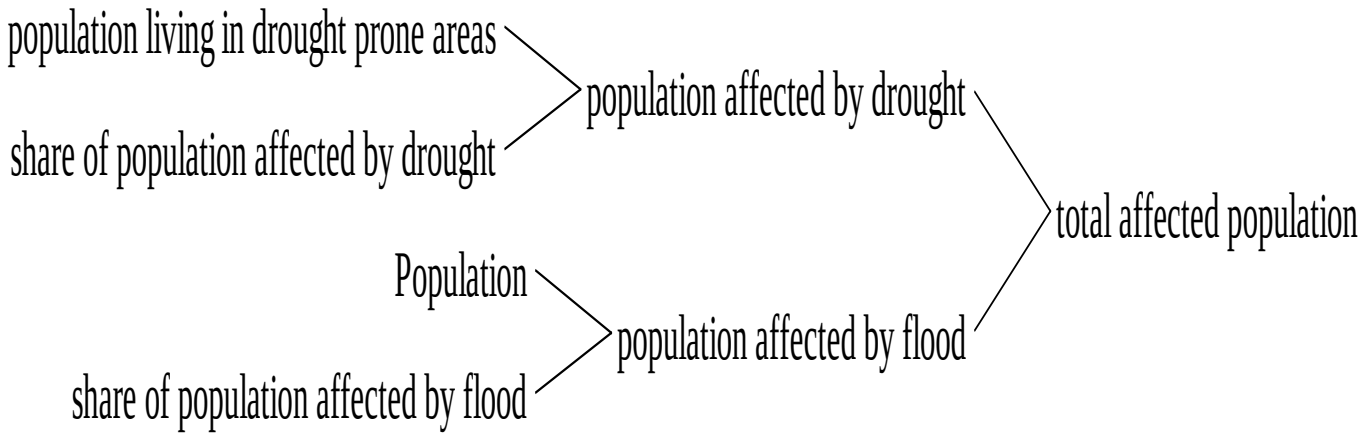


Figure 12.6: Climate impacts on population

Four scenarios for the quantitative assessment of the SEBs of CIS

1) **The No Climate scenario**

…assumes no climate impacts and no investments, and hence represents the current state of macroeconomic planning models.

2) **The Reference (or baseline scenario**)

…assumes 0% coverage throughout the simulation, which implies no anticipation of climate events and hence 100% of damages.

3) **The Business as usual (BAU) scenario**

…assumes 30% coverage throughout the simulation, which translates into an intervention effectiveness of 12%. This means that only 88% of the damages incur.

4) The CIS investment scenario

assumes an increase in CIS coverage from 30% to 95% between 2020 and 2030, and a further increase from 95% to 100% coverage between 2030 and 2040. This translates into an intervention effectiveness of 68% and 74.5% by 2030 and 2040 respectively, which implies that 74.5% of damages can be avoided by 2040.

Affected Agriculture Land and Cumulative Agriculture Land

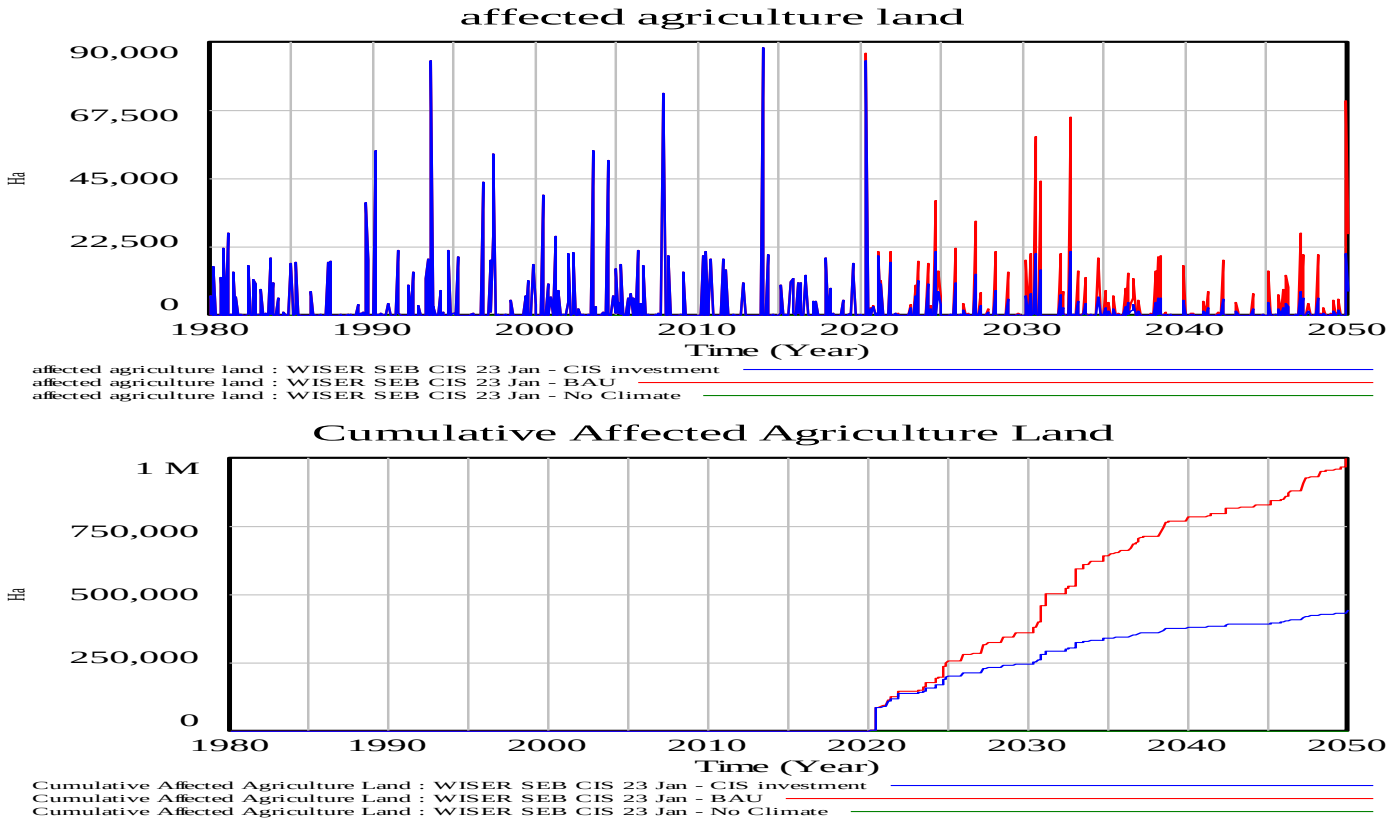


Figure12.13: Affected agriculture land and Cumulative agriculture land affected in all scenarios 1980 to 2050

Real GDP and Cumulative Real GDP

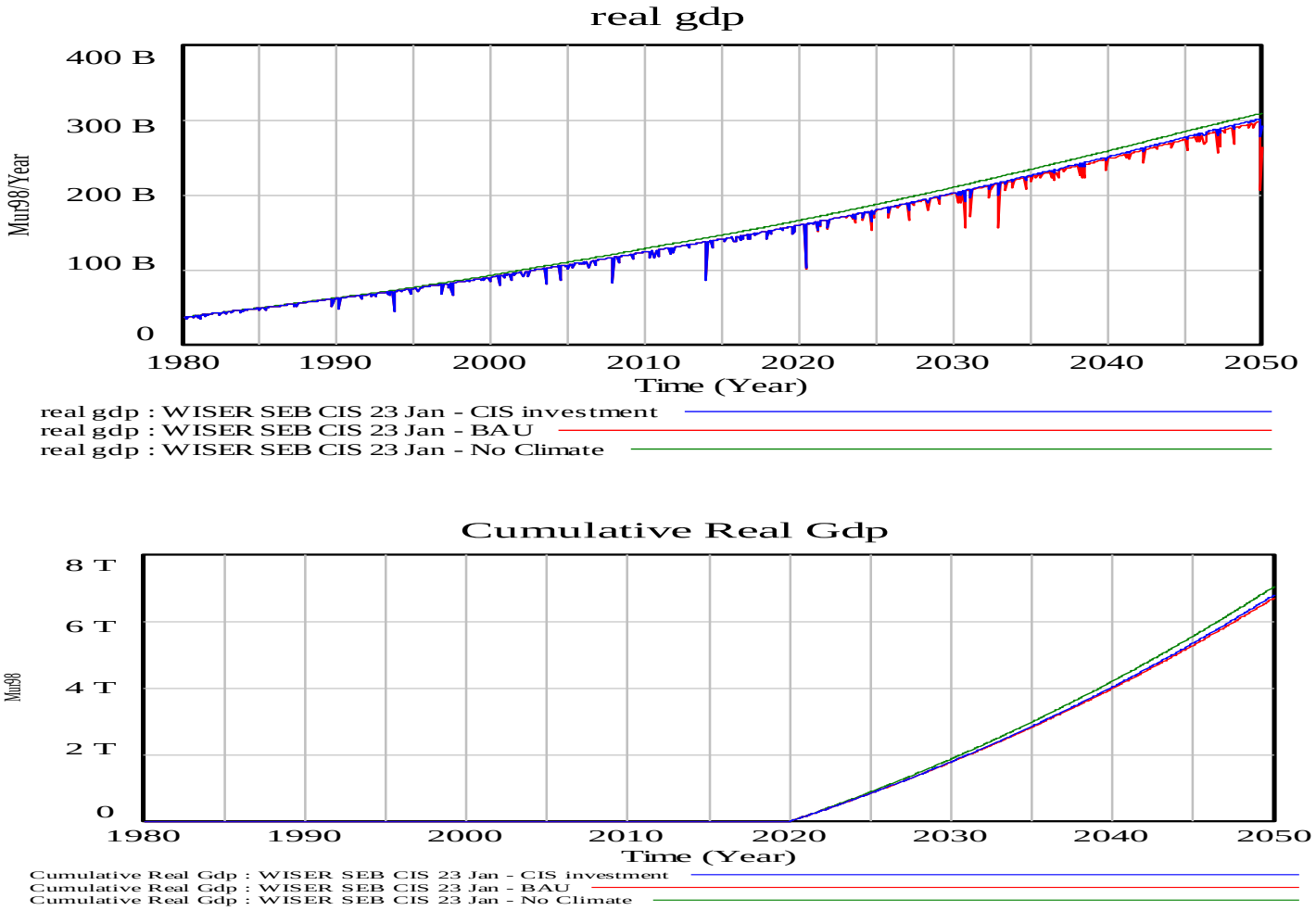
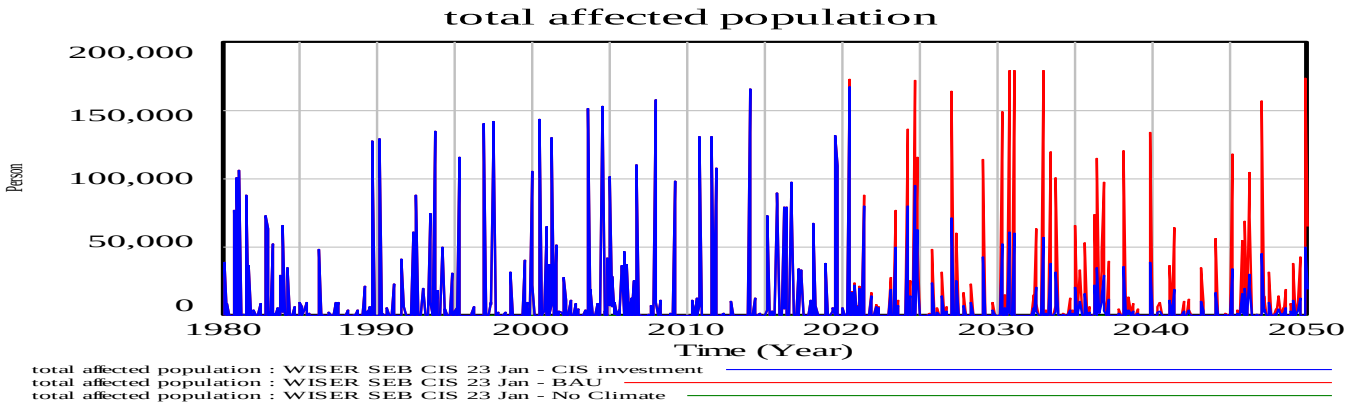


Figure 12.15: Real GDP and Cumulative real GDP in all scenarios 1980 to 2050

Total Affected Population and Cumulative Population



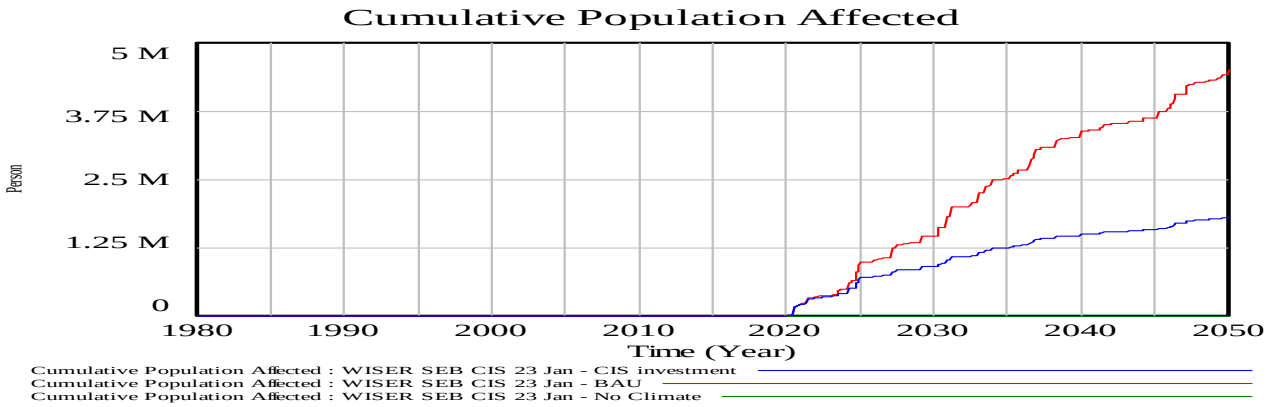
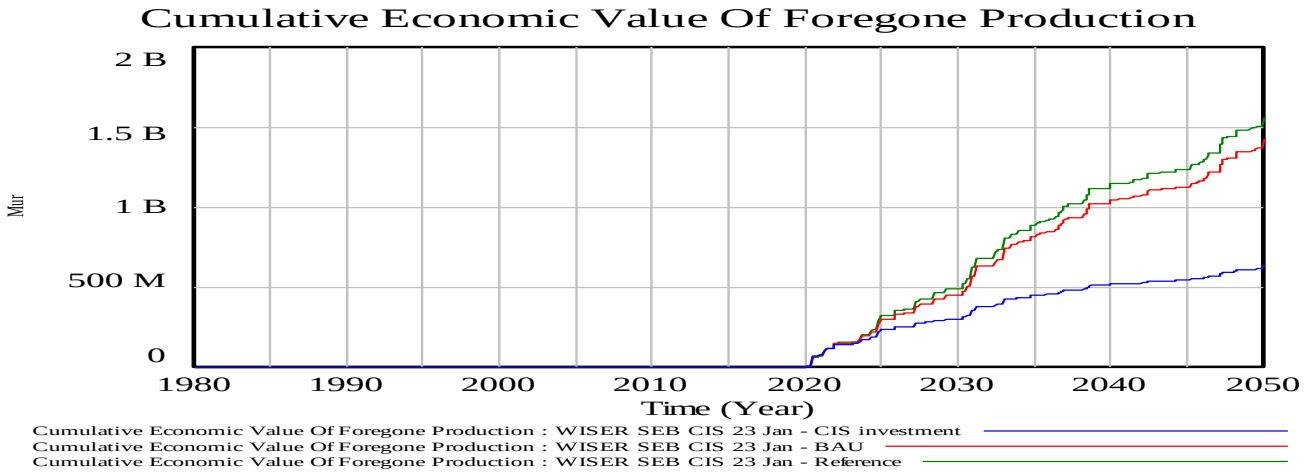


Figure 12.16: Total affected population and Cumulative population affected in all scenarios 1980 to 2050

Cumulative Value of Climate Impacts In Agriculture



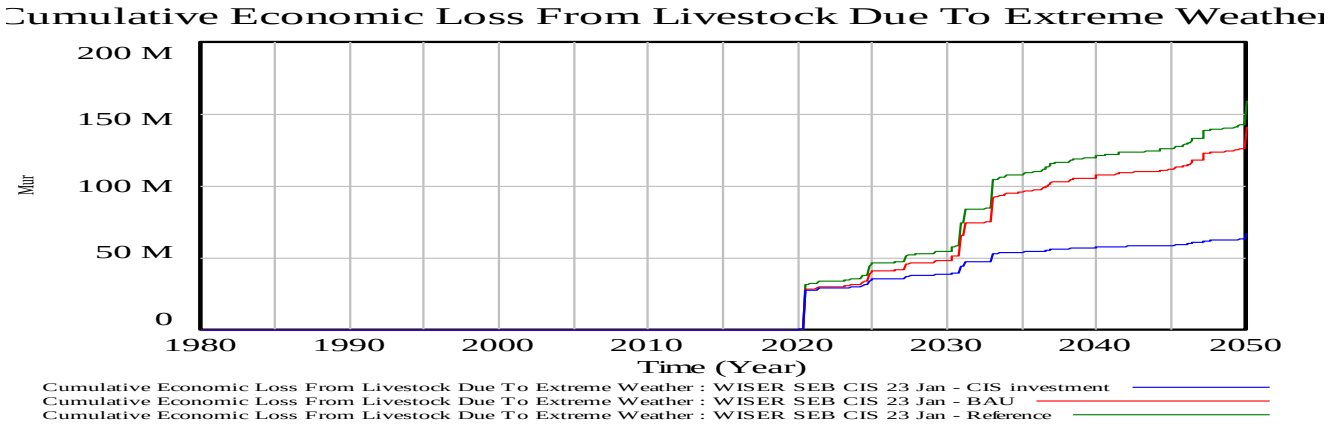


Figure12. 17: Cumulative value of climate impacts in the agriculture sector 2020 to 2050

CIS Coverage and DRR Intervention

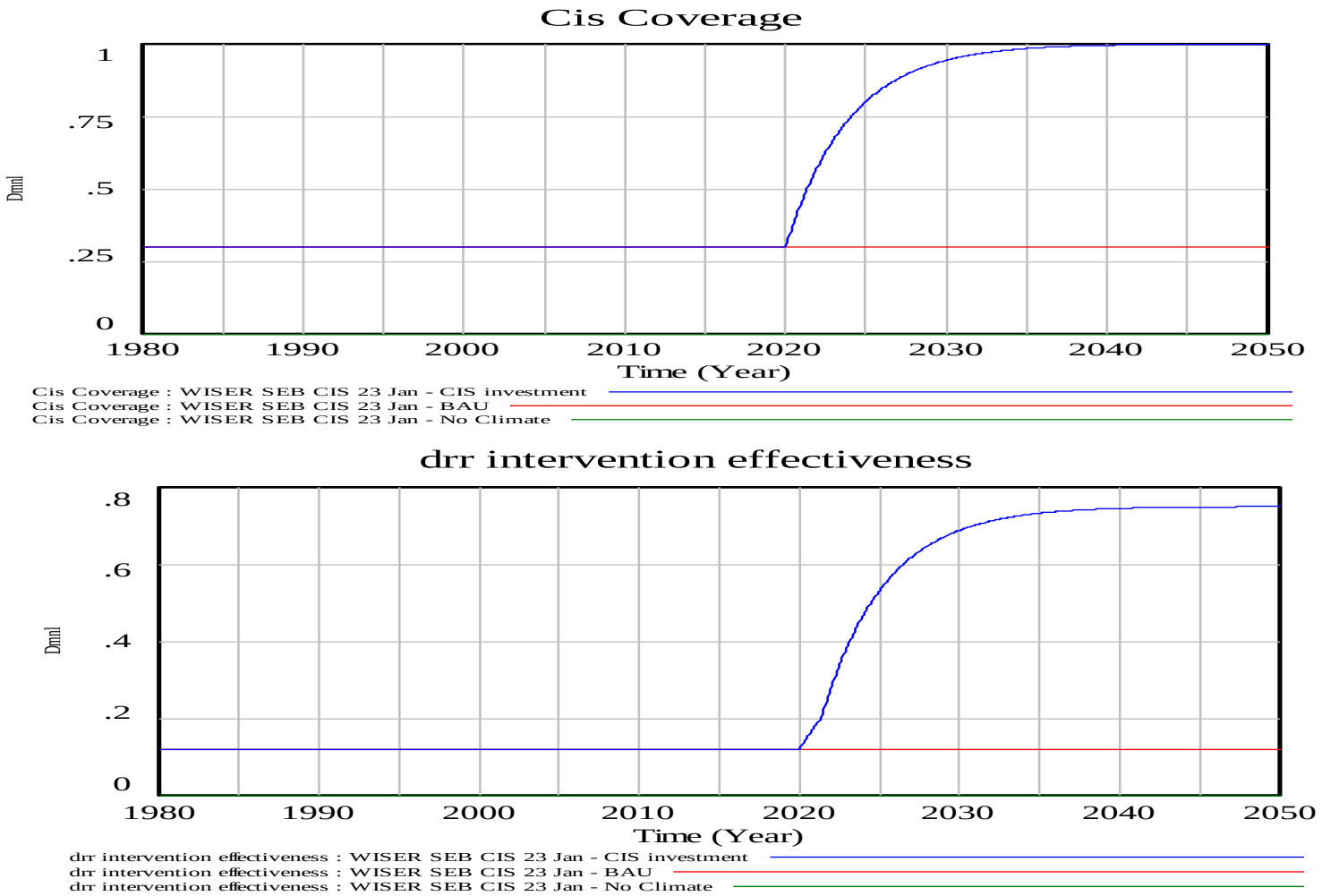


Figure 12.10: CIS coverage and DRR intervention effectiveness all scenarios

Cost of hydrometeorological hazards

Sector	Costs of adverse weather by scenario and 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%

Added Benefits By Scenario And Sector

Table 12.3: Added benefits by scenario and sector

Sector	BAU to Reference	Added benefits CIS investment	Total SEBs	Total investment (in BAU)
	(million USD)	(million USD)	(million USD)	(million USD)
Roads	55.3	244.2	299.5	211.3
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	211.3

Some values of SEBs on CIS

Table 12.1: Overview of SEBs of CIS between 2020 and 2050 by scenario

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

SUMMARY

1	HYDROMETEOROLOGICAL DISASTERS COSTS ARE 10-14 OF GDP
2	INVESTMENTS IN CIS ARE LOW, < 0.1% OF GDP; CURRENTLY CIS IS BETWEEN 0.3 TO 0.6% OF IDEAL
3	SEBS ON CIS FOR DRR HAVE BEEN SUCCESSFULLY DEMONSTRATED THROUGH SYSTEM DYNAMICS MODELLING; CURRENTLY BCR 4-6 TIMES
4	INVESTMENT IN AND APPLYING CIS WILL GREATLTY REDUCE DISASTER IMPACTS ON COMMUNITIES AND INCREASE GDP GROWTH
5	BENEIFTS COST RATIOS OF GREATER THAN 7 TIMES THE INVESTMENTS

WAY FORWARD

1	APPROPRIATE INVESTMENTS IN CIS TO MAKE IT MORE EFFECTIVE AND MORE EFFICIENT TO BENEFIT COMMUNITIES BETTER
2	PILOT PROJECTS IN PARTNERSHIPS WITH RESEARCH INSTITUTIONS/UNIVERSITIES AND RCC IN ORDER TO REFINE THE SEB ON CIS MODELS
3	RISK MAPPING NEED TO BE CARRIED OUT AT SUBREGIONAL AND NATIONAL LEVELS ACROSS SSA.
4	COMPREHENSIVE OUTREACH PROGRAMMES TO IMPROVE UTILIZATION OF CIS; AND ADVOCACY FOR INVESTMENTS IN CIS
5	COMPREHENSIVE TRAINING/OUTREACH TO BE ORGANIZED FOR THE SPECIFIC SECTOR PROFESSIONALS AT SUBREGIONAL AND NATIONAL LEVEL

Thank You For Your Attention