Fondazione Eni Enrico Mattei

ASSESSMENT OF DROUGHT-INFLICTED ECONOMIC AND SOCIAL COSTS

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1. Outline

Xerochore, FP7 CA

Droughts, propagation, compounding factors

Economic assessment of disaster losses: methodological issues

Research gaps

2. Xerochore

Xerochore - An Exercise to Assess Research Needs and Policy Choices in Areas of Drought

FP7 – Support Action (SA)

http://www.feem-project.net/xerochore/

Three major experts and stakeholders workshops will be held in Amsterdam (June 15-17, 2009), Venice (October 5-7, 2009) and Brussels (January 2010)

Xerochore Work Package 2

- Economic costs of droughts
- Water demand vs supply management options

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3.1 Drought

Droughts are natural, human-exacerbated disasters

- ‘ordinary’ water demand cannot be met with the short-term available water resources

Slow and ‘creeping’ phenomena, their onset and end are hard to determine, impacts accumulate with drought conditions persisting over time and after the drought has ended

Droughts engender exogenous supply shocks with far-reaching ripple effects

Palmer Drought Severity Index (PDSI), Crop Moisture Index (CMI), Standardized Precipitation Index (SPI), Soil Moisture and Runoff Index (SMRI) …

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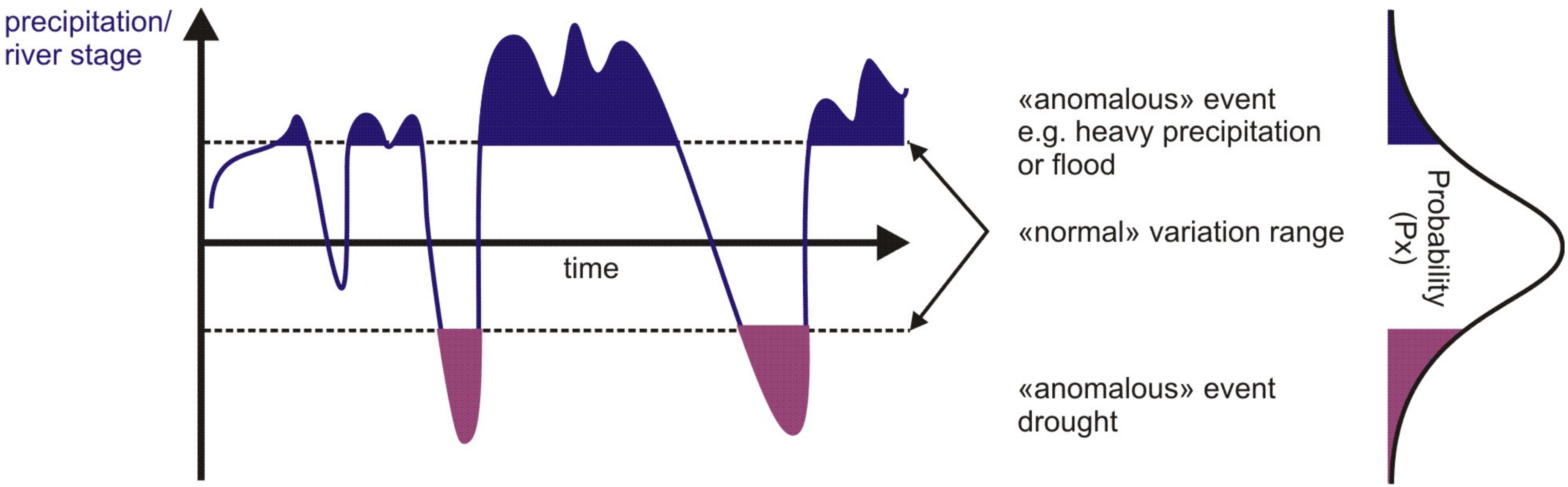
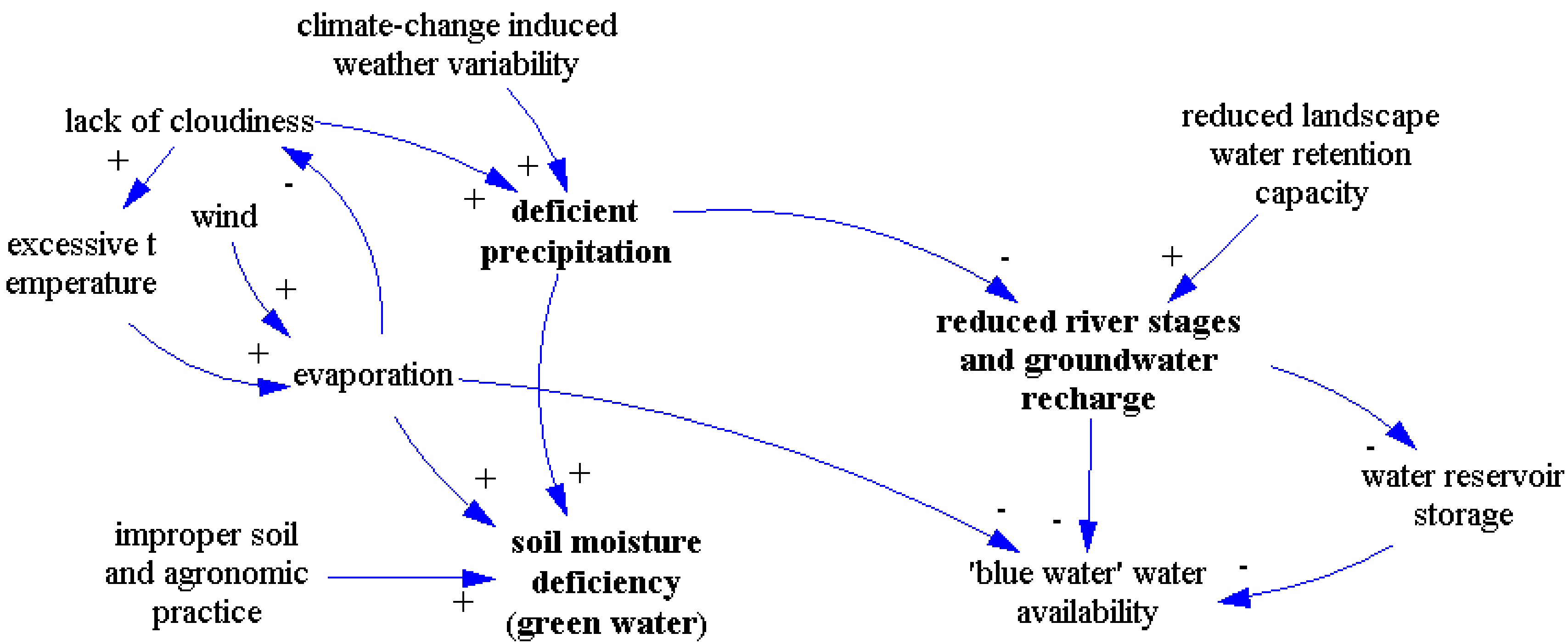
3.2

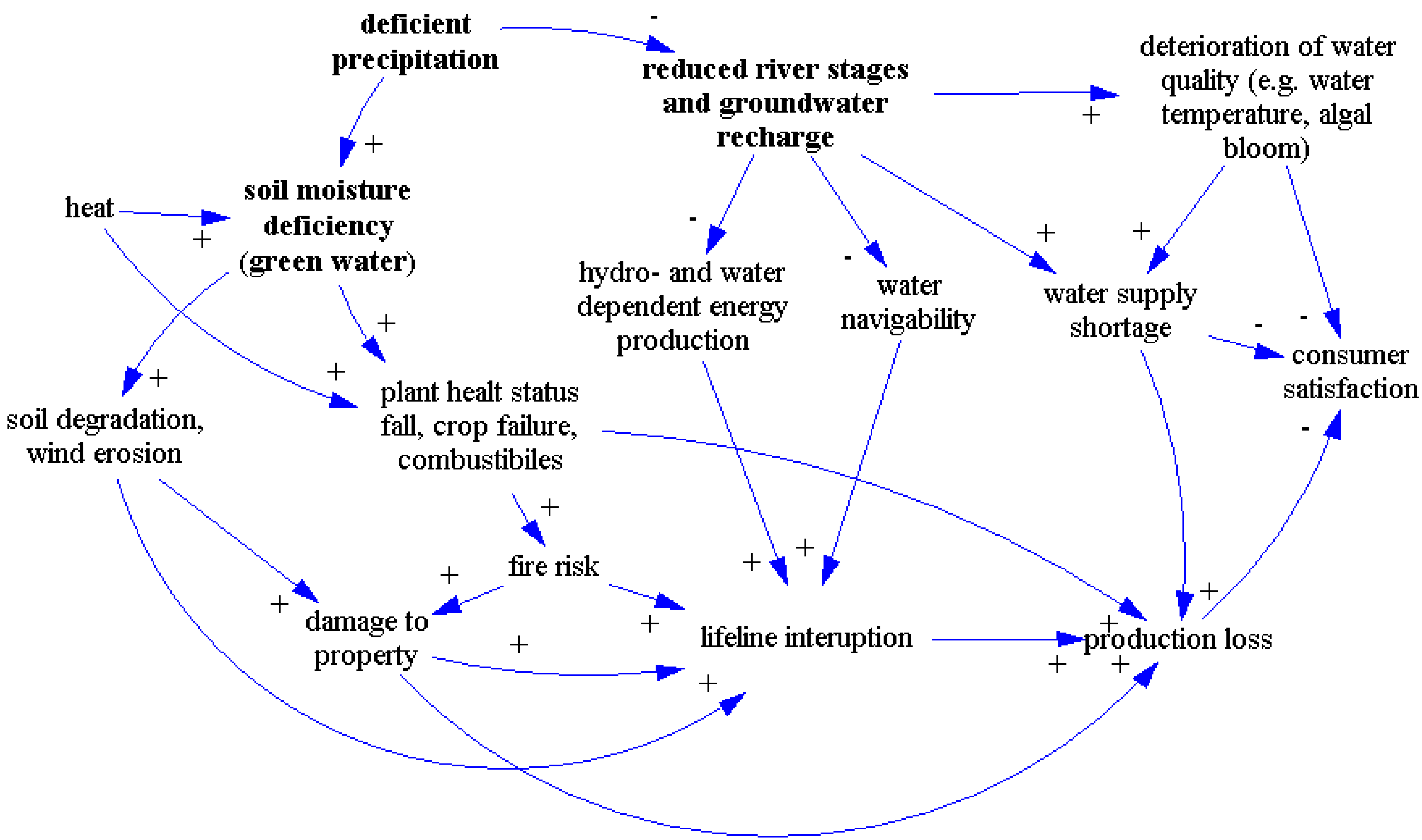
Drought (cont.)



Drought (cont.)



Drought (cont.)



4. Methodological issues

Conceptualisation of losses

Flow versus stocks

Direct versus higher order impacts

Attribution of losses

Distributional effects

Net gains versus net losses

Resilience and vulnerability

Uncertainty

5. Conceptualisation of losses

Existing guidance documents differ in terminology and conceptualisation of losses (ECLAC, NRC, BTE, Heinz Centre for Science …),

- Losses, damage, costs

Social costs = total burden imposed by a disaster ≠ changes in GDP

Value of resource used or destroyed, determined at prices of their efficient allocation

6.1 Examples of cost estimates

Ross and Lott (2003) – 10 drought events in U.S. (1980 and 2003), > 1 billion – 60 billions

Riebsame et al. (1991) – the 1988 drought, $39.4 billions

FEMA – average costs 6-8 billions,

Hayes et al (2004), the 2002 drought, > 13 billions

Howitt et al. (2009), California 2009 drought, 2.2 billions, 80.000 jobs

Adams *et al. (*2002), the 2002 drought event in Australia, 1.6% of GDP decline, 1% of unemployment

RBA (2006), the 2006/7 drought, 20% of Farm GDP, < 1% of GDP

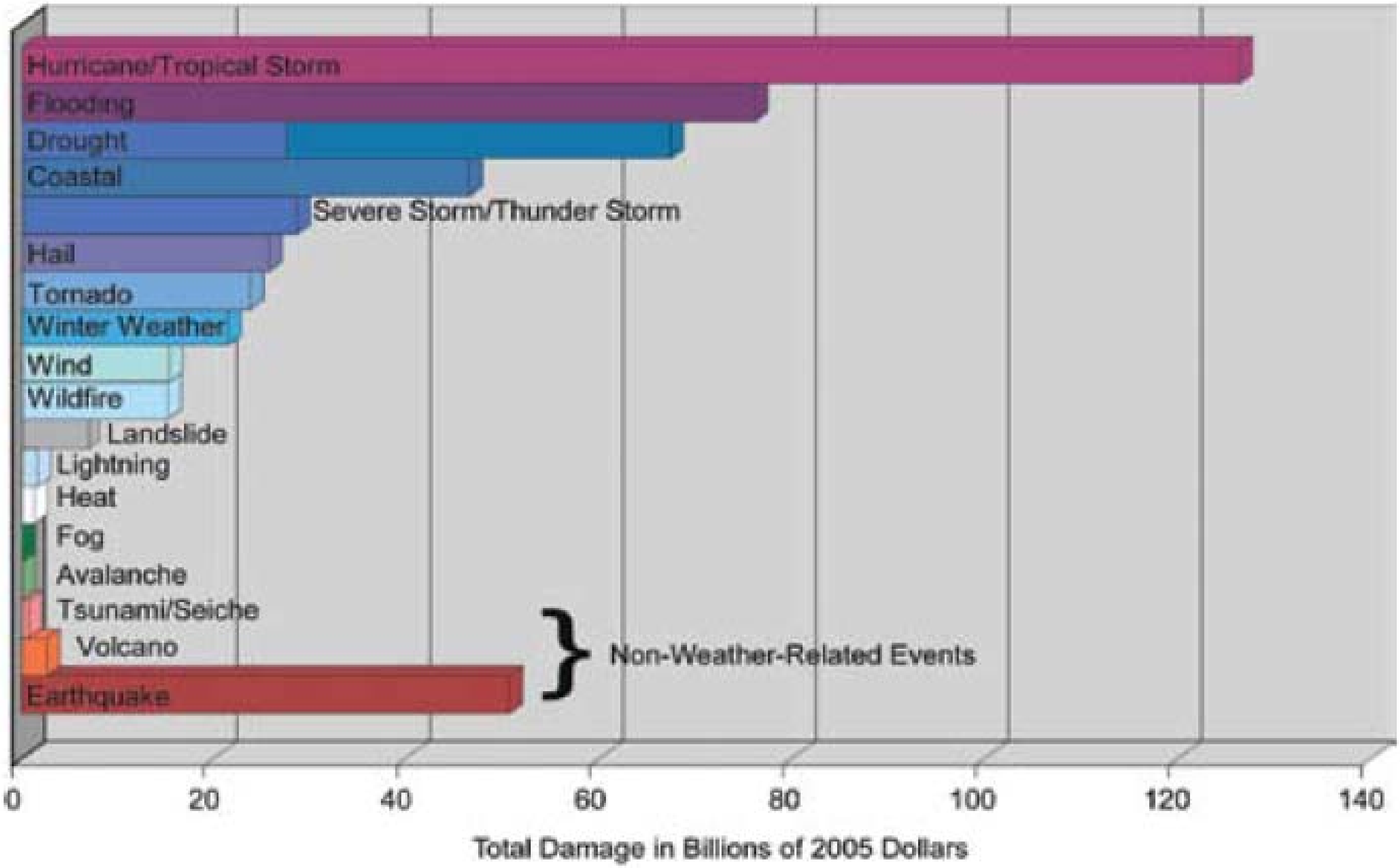


Figure 1.3 The magnitude of total U.S. damage costs from natural disasters over the period 1960 to 2005, in 2005 dollars. The data are from the SHELDUS data base (Hazards and Vulnerability Research Institute, 2007). SHELDUS is an event-based data set that does not capture

Source: Karl et al. 2008, The U.S. Climate Change Science Program, Synthesis and Assessment Product 3.3

6.3 EU Survey

Surveys – DG ENV 2006-2007 study

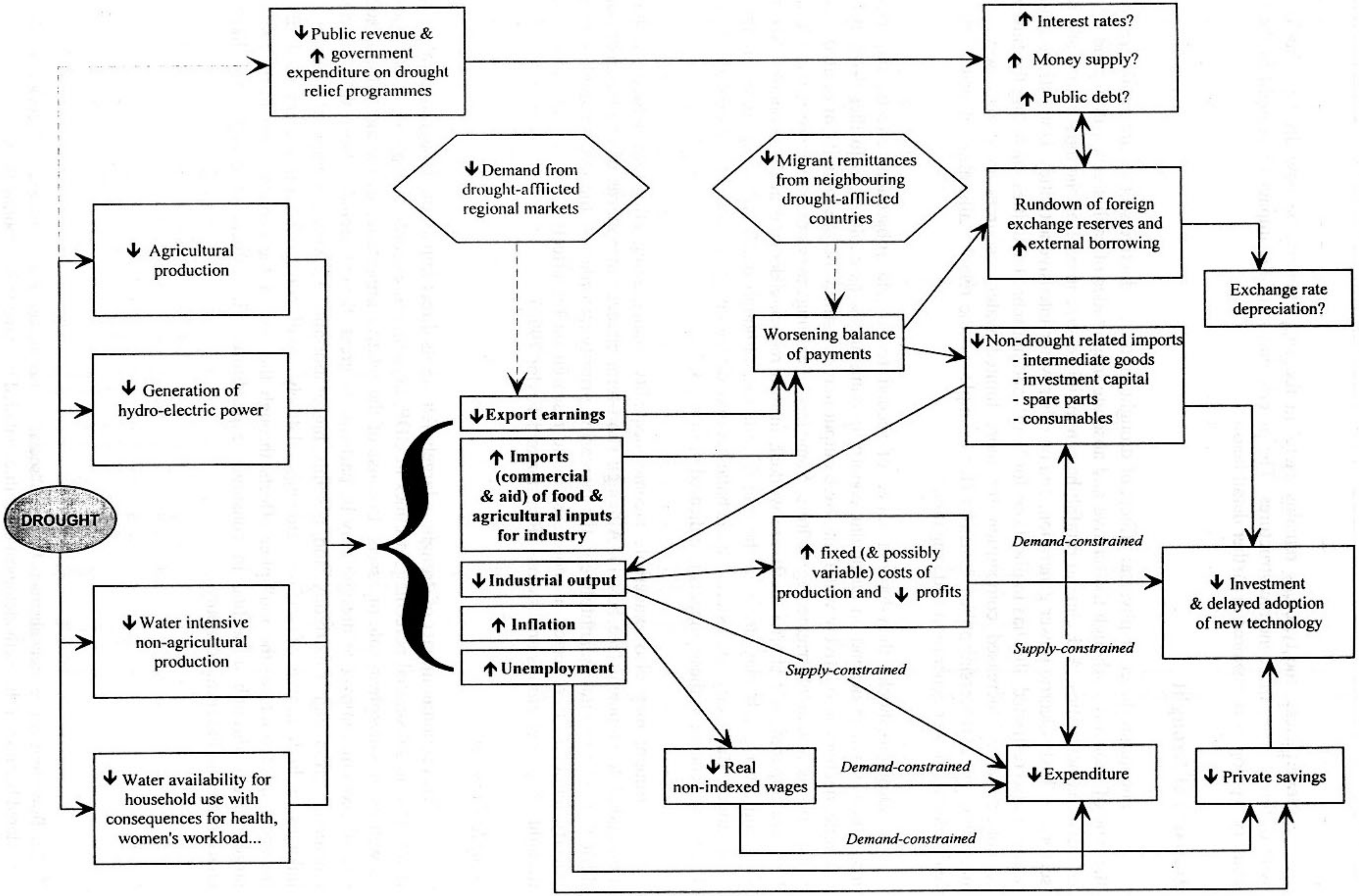
Losses ~ 100 billion € over past 30 years

Annual average impact doubled between the 1976-1990 and 1991-2006

Most recent years, ~ 6.2 billion €/year,

8.7 billion € in 2003.

Direct and higher order impacts



Source: Benson and Clay, 1998

8.1 Stocks and Flows (double counting)

Direct stock losses may include land value reduction, failure of perennial crops (e.g., orchards, groves, vineyards), soil degradation by wind erosion and/or damage to any productive capital damaged as a direct consequence of water shortages

Higher-order stock losses can include fire-destroyed property, depleted savings, or over-abstraction of aquifer

8.2 Stocks and flows (cont.)

Direct flow losses can include reduction of farm outputs, drought-forced downturn in tourism, and/or losses due to business interruption. An example of the latter is the necessity to close down a high-rise office building for fire-safety reasons (Rose 2004a).

Higher-order flow losses can include decline in investments not related to drought mitigation, drop in national income, opportunity costs of drought-related budget expenditure, increase in food imports etc

9.1 Attribution of losses

IPCC TAR, AR4 – cautious acknowledgment of the climate signal,

- AR4 refers to Muir Wood et al. (2006) who found a small statistically significant trend for a 2% increase per year in annual catastrophe losses since 1970

U.S. Global Change Research Programme (USGCRP) more pronounced about the climate signal in disaster losses

Compounding factors: growing wealth, population, settlement pattern, past adaptation measures …

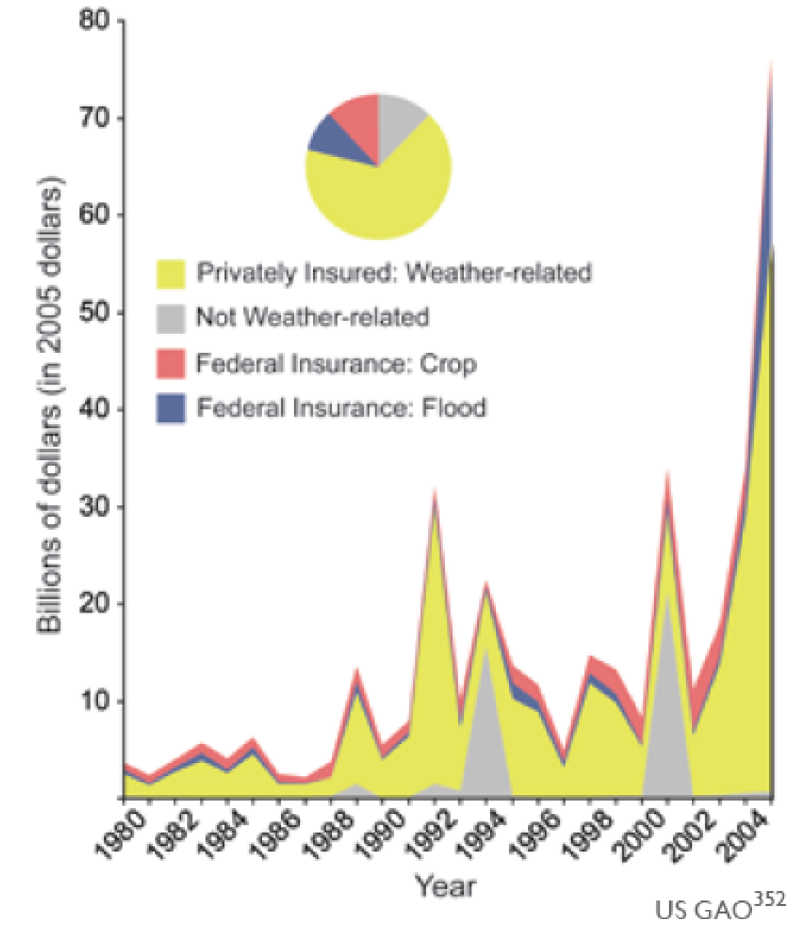
Mills, E., 2005: Insurance in a climate of change. Science, 309(5737), 1040-1044.

9.2

While economic and demographic factors have no doubt contributed to observed increases in losses,[346] these factors do not fully explain the upward trend in costs or numbers of events.[344,347] For example, during the time period covered in the figure to the right, population increased by a factor of 1.3 while losses increased by a factor of 15 to 20 in inflation-corrected dollars. Analyses asserting little or no role of climate change in increasing the risk of losses tend to focus on a highly limited set of hazards and locations. They also often fail to account for the vagaries of natural cycles and inflation adjustments, or to normalize for countervailing factors such as improved pre- and post-event loss prevention (such as dikes, building codes, and early warning systems).[348]

Global Climate Change Impacts in the United States, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.

Insured Losses from Catastrophes, 1980 to 2005



Weather-related insurance losses in the United States are increasing. Typical weather-related losses today are similar to those that resulted from the 9/11 attack (shown in gray at 2001 in the graph). About half of all economic losses are insured, so actual losses are roughly twice those shown on the graph. Data on smaller-scale losses (many of which are weather-related) are significant but are not included in this graph as they are not comprehensively reported by the U.S. insurance industry.

10.1 Distributional effects

Hazard impacts are not borne proportionally, the losses of some agents may be to some extent offset by the gains of others.

Farms outside of drought-hit area may benefit from higher crop prices; railroads may benefits from reduced water transportations; and the sales of technologies for well drilling, weather modification, and chemicals for suppressing evaporation can be boosted by droughts (Riebsame *et al.* 1991)

10.2 Distributional effects (cont.)

Net regional losses (NRL) which include all direct and higher-order effects are partly offset by inflow of payments from outside the region IOR (e.g. rebuilding stimulus, unemployment compensations, other aid) and by transfer of production within the region.

The net national losses (NNL) consists of NRL and IOR, reduced by the benefits transferred outside of the impacted region (e.g. tourism offset or recaptured lost production) (Cochrane 2003).

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11.1 Resilience and vulnerability

Kal, *The Economist* May 21st 2009

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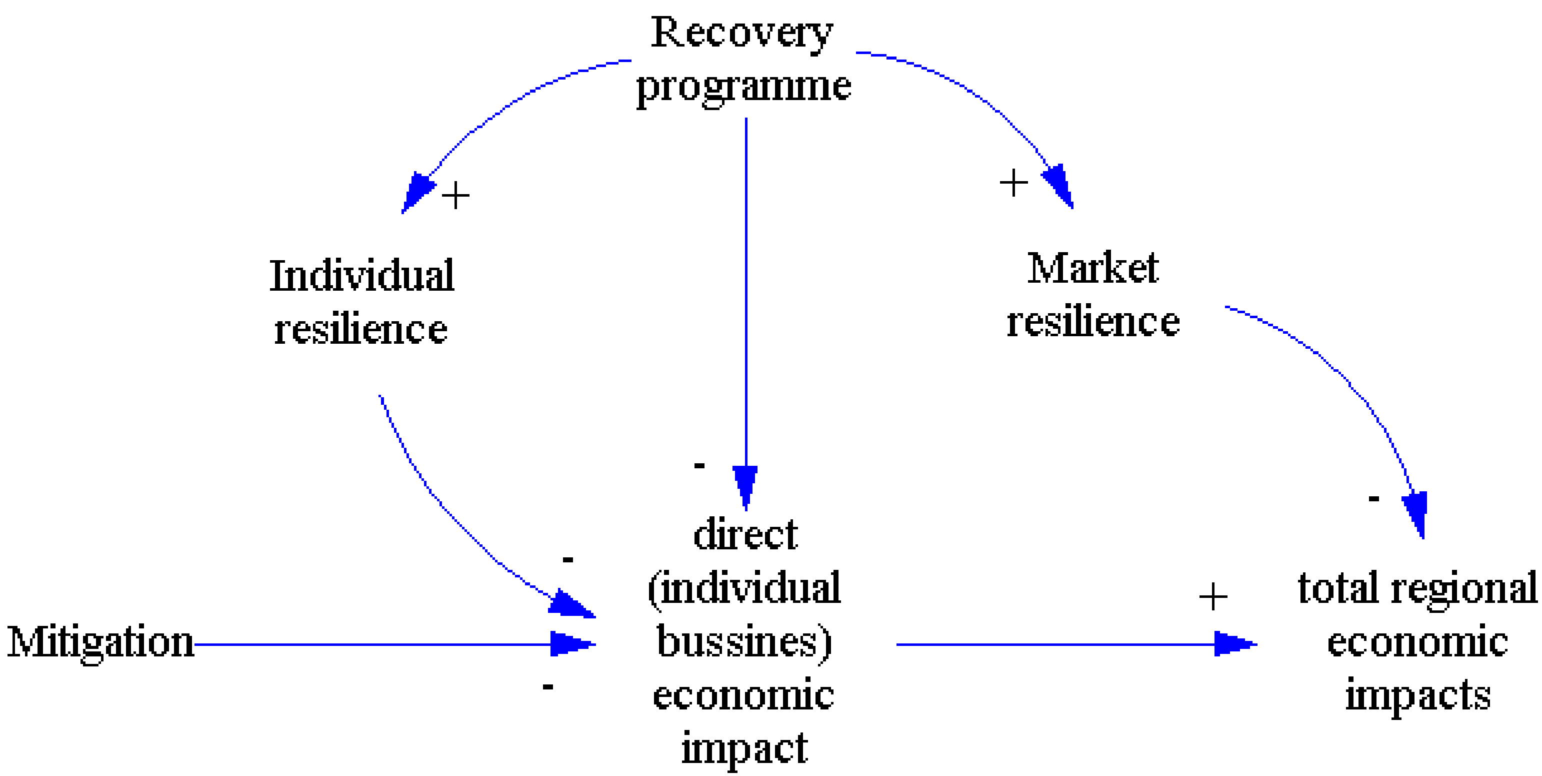
Resilience and vulnerability (cont.)



Resilience and vulnerability (cont.)

Briguglio et al. (2008): macroeconomic stability (e.g. fiscal deficit, unemployment and inflation rates), microeconomic market efficiency (e.g. trade freedom), state's governance and social development (e.g. literacy rate, life expectancy)

Cordona et al. (2008) - internal and external funds available to a government to face the hazard losses (e.g. ability to deploy new taxes, budget reallocation margins, external and internal credit, aid funds and donations).

11.4

Resilience and vulnerability (cont.)

Rose (2007)

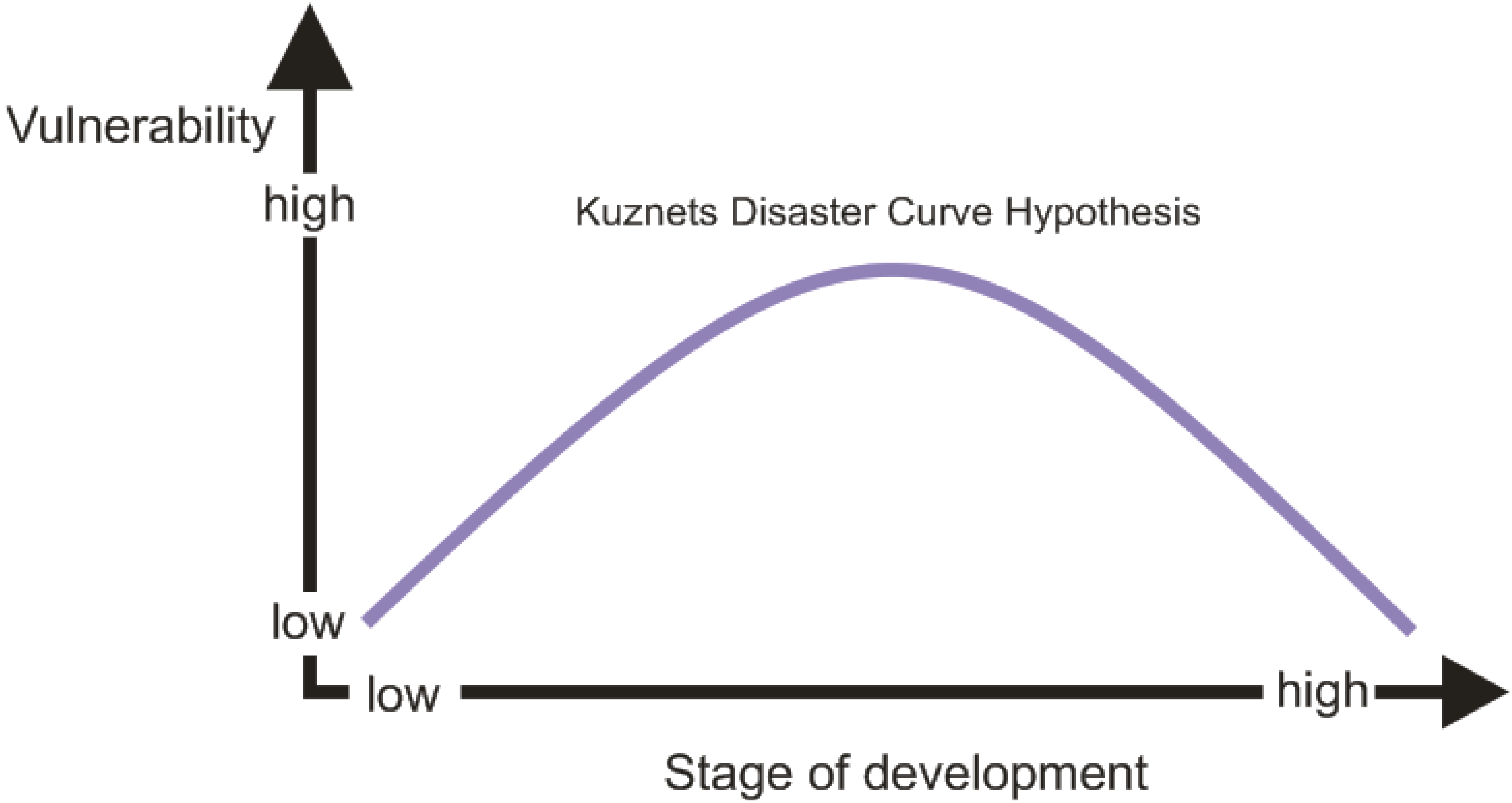
Static resilience aligned with efficient allocation of resources

Dynamic resilience include long-term investments and institutional changes.

Inherent resilience is the ordinary ability to deal with crises, for example by tapping groundwater in cases the water delivery from surface water sources cannot be guaranteed.

Adaptive resilience refers to extra-efforts and makeshift solutions to the disaster calamity.

11.5 Kuznets Disaster Curve Hypothesis



(Economic structure, prevailing economic and policy conditions)

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12.1 Net gains versus net losses

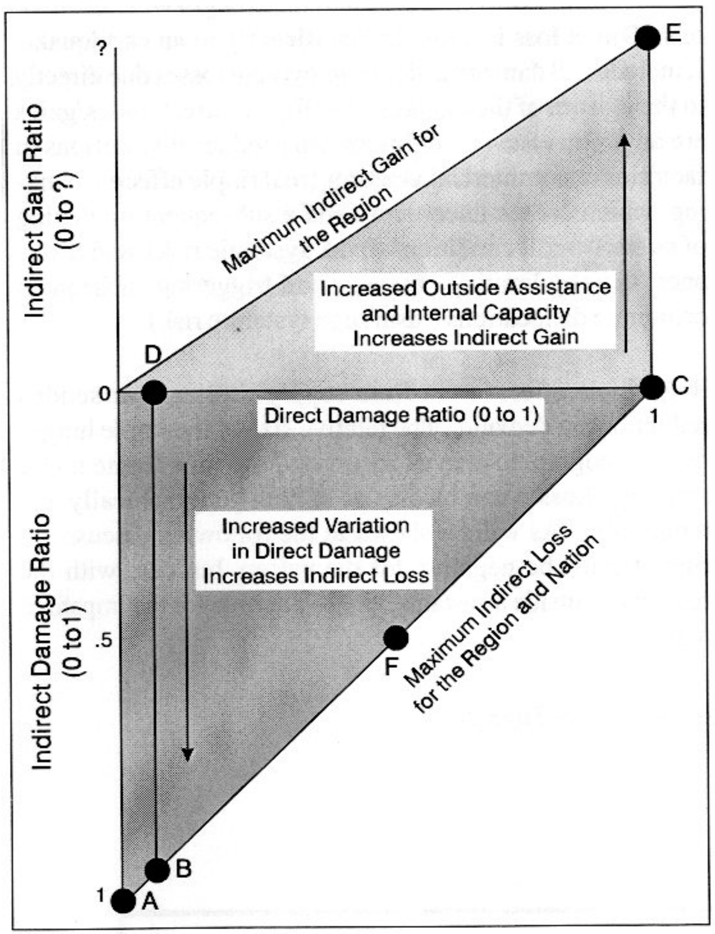

Figure 1: Relationship Between Direct and Indirect Damages and Gains: Regional Perspective

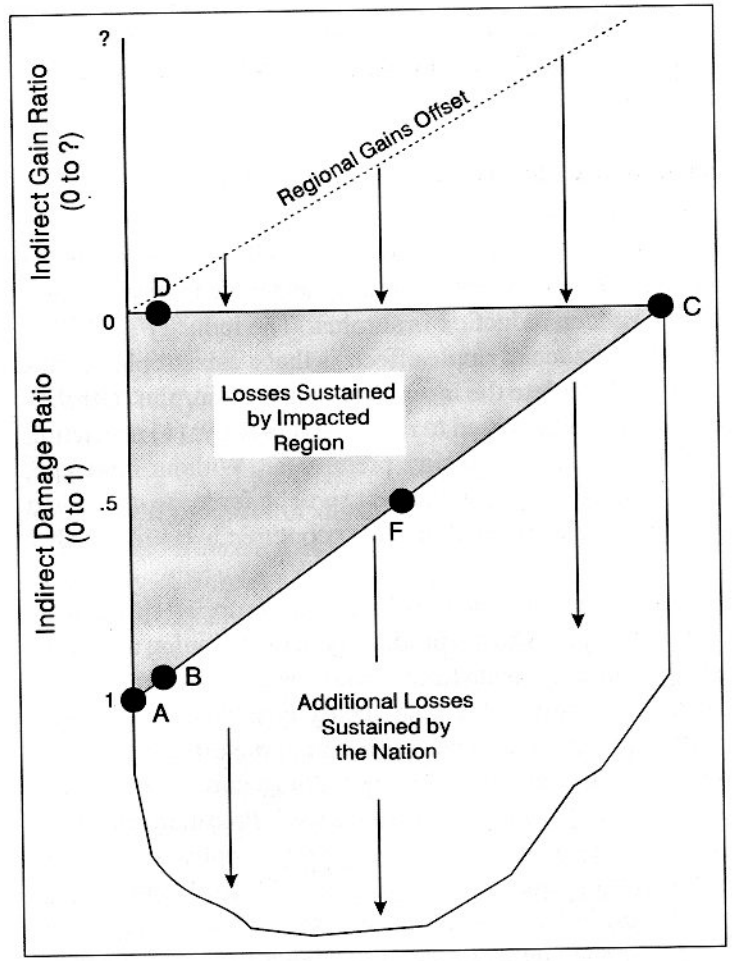

Figure 2: Relationship Between Direct and Indirect Damages and Gains: A National Perspective

12.2 Net gains versus net losses (cont.)

Post-disaster reconstruction and relief payments may generate a boom in the economy and on the regional level to some extent offsetting the hazard losses (Albala Bertrand 1993).

Replacement of capital provides opportunity for productivity-rising innovations (creative destruction, Aghion and Howitt, 1998).

In the short-term, disasters negatively affect income generation, investment, consumption, production, employment and financial flows, and these losses are usually manifested through decline of macroeconomic variables such as GDP (Benson & Clay 2003)

13. Uncertainty

Data quality,

Assumptions (future discounting, normalisation, ..),

Approximation of higher-order and intangible impacts,

Attribution of observed economic changes to drought,

Methodological choices, model parameters

probability distribution function describing likelihood of the total losses having a particular value,

a point estimate and/or a range the losses should fall between with a given probability,

order of magnitude of losses

14. Methodologies

Linear programming models, surveys, econometric models, input-output (IO) models, computable general equilibrium models (CGE), and hybrid models,

Input-output models do not take account of behavioural changes and input substitutions, thus upper bound estimate of the losses,

Computable general equilibrium models assume perfect adjustment to equilibrium which may lead to over-resilient responses, thus lower-bound estimate,

15. Research gaps

Harmonise different conceptualisations of losses, provide a comprehensive and coherent guidance (not an exact model),

Improve drought loss data collections including higher-order and intangible impacts,

Subject assessment of drought-related losses to uncertainty analysis.

More detailed studies are needed to advance the drought economics: cumulative effects of series of droughts, the role of economic resilience and public policy responses

Thank you for your attention