Socio-economic impacts of droughts and economic instruments

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# Policy challenge

**Table 1:** Ten Global Risks of Highest Concern in 2014

<table>
<thead>
<tr>
<th>No.</th>
<th>Global Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fiscal crises in key economies</td>
</tr>
<tr>
<td>2</td>
<td>Structurally high unemployment/underemployment</td>
</tr>
<tr>
<td>3</td>
<td>Water crises</td>
</tr>
<tr>
<td>4</td>
<td>Severe income disparity</td>
</tr>
<tr>
<td>5</td>
<td>Failure of climate change mitigation and adaptation</td>
</tr>
<tr>
<td>6</td>
<td>Greater incidence of extreme weather events (e.g. floods, storms, fires)</td>
</tr>
<tr>
<td>7</td>
<td>Global governance failure</td>
</tr>
<tr>
<td>8</td>
<td>Food crises</td>
</tr>
<tr>
<td>9</td>
<td>Failure of a major financial mechanism/institution</td>
</tr>
<tr>
<td>10</td>
<td>Profound political and social instability</td>
</tr>
</tbody>
</table>

Note: From a list of 31 risks, survey respondents were asked to identify the five they are most concerned about.

Policy challenge

Top 5 Global Risks in Terms of Impact

<table>
<thead>
<tr>
<th>Year</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>Asset price collapse</td>
<td>Retrenchment from globalization</td>
<td>Interstata and civil wars</td>
<td>Pandemics</td>
<td>Oil price shock</td>
</tr>
<tr>
<td>2008</td>
<td>Asset price collapse</td>
<td>Retrenchment from globalization</td>
<td>Slowing Chinese economy (&lt;5%)</td>
<td>Oil and gas price spike</td>
<td>Pandemics</td>
</tr>
<tr>
<td>2009</td>
<td>Asset price collapse</td>
<td>Retrenchment from globalization</td>
<td>Oil price spikes</td>
<td>Chronic disease</td>
<td>Fiscal crises</td>
</tr>
<tr>
<td>2010</td>
<td>Asset price collapse</td>
<td>Retrenchment from globalization</td>
<td>Geopolitical conflict</td>
<td>Chronic disease</td>
<td>Fiscal crises</td>
</tr>
<tr>
<td>2011</td>
<td>Fiscal crises</td>
<td>Climate change</td>
<td>Food shortage crises</td>
<td>Chronic fiscal imbalances</td>
<td>Extreme energy price volatility</td>
</tr>
<tr>
<td>2012</td>
<td>Major systemic financial failure</td>
<td>Water supply crises</td>
<td>Chronic fiscal imbalances</td>
<td>Extreme volatility in energy and agriculture prices</td>
<td>Failure of climate change adaptation</td>
</tr>
<tr>
<td>2013</td>
<td>Major systemic financial failure</td>
<td>Watersupply crises</td>
<td>Diffusion of weapons of mass destruction</td>
<td>Unemployment and underemployment</td>
<td>Critical Information Infrastructure breakdown</td>
</tr>
<tr>
<td>2014</td>
<td>Fiscal crises</td>
<td>Climate change</td>
<td>Water crises</td>
<td>Water crises</td>
<td>Critical Information Infrastructure breakdown</td>
</tr>
</tbody>
</table>

Policy challenge

WATER SECURITY
- Access to safe drinking water and sanitation
- Adequate livelihoods
- Resilience to water hazards
- Environmental sustainability
- Peace & stability

National and Regional Water Governance
- Food-water (Green & Blue)
- Agriculture
- Non-food water (Blue)
- Cities/Towns
- Mining
- Energy
- Industry

Socio-economic trends
- Income/Jobs
- Technology
- Human and social capital
- Urbanization
- Transportation
- Equity and democracy
- International commodity prices

Global Governance
- Trade policy (WTO) – G20
- Free Trade Agreements (Bilat, Multi Lat, Regional)
- Food safety and sanitary measures
- Economic

LAC FOOD SECURITY
- Food production
- Food access Nutritional quality
- Stability Safety

GLOBAL FOOD SECURITY

National and Regional Agricultural Policies
- Food programmes
- Rural development
- Agricultural extension
- Credit & insurance
- Trade policies
- Infrastructure
- Gender policies
- Minimum wage
Content

1. Framework for thinking about drought socio-economic impacts
2. Economic impacts
3. Economic instruments
4. Virtual water trade
5. The role of insurance
1. Framework for thinking about drought socio-economic impacts

Mild drought (1st year)                  Severe drought (2nd year)

Aggregate Direct costs (£)

Socio-economic direct costs (£)

Drought index (Storage)

Drought Index (SPI)

Rainfed agric

Irrig agric

Hydropower

Forestry

Recreation

Urban sector

Pre-Alert

Alert

Emergency

10/1/t  1/1/t+1  1/4/t+1  1/7/t+1  1/10/t+1  1/1/t+2  1/4/t+2  1/7/t+2  1/10/t+2
1. Framework for thinking about drought socio-economic impacts

Categorisation of drought impacts
Note: Notation for Domains Residential Sector (RS); Economic sector (ES) and Environment (EV)

<table>
<thead>
<tr>
<th>Type of impacts</th>
<th>Direct</th>
<th>Indirect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Welfare impacts (RS) Environmental impacts (EV) - Aquatic ecosystems - Forest ecosystems</td>
<td>Humans health and disease exposure</td>
</tr>
<tr>
<td>Intangible (Non-market impacts)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 2. Economic impacts

<table>
<thead>
<tr>
<th>Sector</th>
<th>Type of Impact</th>
<th>Methodology</th>
<th>Reliability</th>
<th>Value (Million €)</th>
<th>% of importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban water supply</td>
<td>Alleviation and mitigation measures</td>
<td>Gathered from government sources</td>
<td>High</td>
<td>136.34</td>
<td>13.63</td>
</tr>
<tr>
<td></td>
<td>Water supply companies</td>
<td>-</td>
<td>High</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Additional private costs</td>
<td>Estimated</td>
<td>Low</td>
<td>15.89</td>
<td>1.59</td>
</tr>
<tr>
<td>Agriculture and livestock</td>
<td>Alleviation and mitigation measures</td>
<td>Gathered from government sources</td>
<td>High</td>
<td>29.03</td>
<td>2.90</td>
</tr>
<tr>
<td></td>
<td>Insurance claims and indemnity losses</td>
<td>Estimated with data from ENESA</td>
<td>Reasonable/Indicative</td>
<td>22.81</td>
<td>2.28</td>
</tr>
<tr>
<td></td>
<td>Reinsurance impacts</td>
<td>Estimated from data of the CCS</td>
<td>Reasonable/Indicative</td>
<td>23.80</td>
<td>2.38</td>
</tr>
<tr>
<td></td>
<td>Value of agricultural production</td>
<td>UPM modeling approach</td>
<td>High</td>
<td>384.84</td>
<td>38.48</td>
</tr>
<tr>
<td></td>
<td>Livestock production and health</td>
<td>Estimated from various sources</td>
<td>High</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hydroelectric</td>
<td>Cost of extra energy</td>
<td>UPM approach</td>
<td>High</td>
<td>385.00</td>
<td>38.50</td>
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<tr>
<td>Industry</td>
<td>Aquaculture</td>
<td>UPM with industry data</td>
<td>High</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cut flowers and greenhouses</td>
<td>High</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Forest products</td>
<td>Government estimates</td>
<td>High</td>
<td>2.34</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>Navigation</td>
<td>Reasonable/Indicative</td>
<td>Unknown</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreational uses</td>
<td>Recreational and sports fishing</td>
<td>Estimates from sectoral studies and official data</td>
<td>Reasonable/Indicative</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skating</td>
<td>Reasonable/Indicative</td>
<td>Significant but unknown</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL DIRECT TANGIBLE COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td>1000.05</td>
<td>100</td>
</tr>
<tr>
<td>Agro‐industry</td>
<td>UPM modeling approach</td>
<td>High</td>
<td>589.04</td>
<td>99.93</td>
<td></td>
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<tr>
<td>Employment</td>
<td></td>
<td>High</td>
<td>Not significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tourism</td>
<td>Estimates from sectoral studies and official data</td>
<td>Low</td>
<td>6.36</td>
<td>1.07</td>
<td></td>
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<tr>
<td><strong>TOTAL INDIRECT TANGIBLE COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td>595.4</td>
<td>100</td>
</tr>
<tr>
<td>Social water uses</td>
<td>Benefit transfer</td>
<td>Reasonable/Indicative</td>
<td>0.23</td>
<td>0.01</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Reasonable/Indicative</td>
<td>0.53</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reasonable/Indicative</td>
<td>1.16</td>
<td>0.04</td>
<td></td>
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<tr>
<td>Risk perception</td>
<td></td>
<td>Low/Doubtful</td>
<td>2861.19</td>
<td>99.62</td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td></td>
<td>Reasonable/Indicative</td>
<td>8.86</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL DIRECT INTANGIBLE COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td>2871.99</td>
<td>100</td>
</tr>
</tbody>
</table>
2. Economic impacts

Direct Impacts

Agriculture:
- Rainfed agriculture
- Irrigated agriculture
- Livestock

**Urban sector:**
- Households’ welfare
- Institutional customers
- Industries/services
- Parks and street cleaning

Tourist sector
- Energy
- Environment

Indirect Impacts

Agrifood sector
- Food processing industries
- Ag. Input industries

**Urban sector business:**
- Hotels, restaurants, bars

Tourist industry
- Golf courses, resources
2. Economic impacts

• Droughts have direct impact on domestic water supply and on water-dependant economic sectors, such as irrigation and hydroelectricity production, Agro-industry, on water and precipitation-dependant, and on other economic activities.

• Non-market impacts include social welfare reductions and impaired environment.

• The cost of the measures implemented to mitigate, prevent or alleviate the impacts of drought can also be attributable to the economic cost of the drought.

• Existing information on economic impacts of droughts is scarce, incomplete, unreliable and scattered

• Drought impacts on natural ecosystems are difficult to value in economic terms.
2. Economic impacts

Agricultural Impacts

Scope

- Farm $i$
- Groups of farms
- Comarca/county
- Provincial level
- Regional level
- National level

Indirect effects / concerns

- Household’s distress
- Financial difficulties
- External labour
- Cooperatives distress
- Local industries
- Tax receipts
- Drought insurance
- Indemnities
- Reduced GNP
2. Economic impacts

Figure 3: Key entry points for policy and investment used in modeling

- Domestic Biofuel Prodn
- Policy drivers
- Socioeconomic drivers
- Caloric Availability
  - Child malnutrition
  - Clean water access
  - Female education

- Irrigation investments
  - Rural Roads
  - Ag R&D investments

- Supply
  - Area
  - Yield
  - Climate change
    - environmental driver

- Demand
  - Other Demand
    - Feed
    - Food

- Trade policy
  - Trade Equilibrium Balance
  - Agric imports/exports
### 3. Economic instruments

#### Ex - ante

<table>
<thead>
<tr>
<th>Early stages</th>
<th>Critical stage</th>
<th>Ex - post</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incentive-based</strong></td>
<td><strong>Agricultural droughts</strong></td>
<td><strong>Ex - post</strong></td>
</tr>
<tr>
<td>Risk-analysis + Early warning</td>
<td>Training, outreach &amp; Preparation</td>
<td>Emergency Reconstruction</td>
</tr>
<tr>
<td>Automatic</td>
<td>Insurance</td>
<td>Insurance + eligibility</td>
</tr>
<tr>
<td><strong>Compensatory</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Past drought

<table>
<thead>
<tr>
<th>Operational droughts</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pricing</td>
<td>Emergency Reconstruction</td>
<td></td>
</tr>
<tr>
<td>Awareness campaigns</td>
<td>Allocative mechanisms</td>
<td></td>
</tr>
<tr>
<td>Optioning rights</td>
<td>Water banks</td>
<td></td>
</tr>
<tr>
<td>Spot water markets</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Economic instruments

Conceptual map of the measures applied on agriculture (in Spain)

Source: Nuria Hernández-Mora, Marina Gil and Alberto Garrido
Assessment Report Ebro Case Study – Droughts
Preempt Project http://www.feem-project.net/preempt/
## 4. Virtual water trade

### Some water shortage combinations foreseen by 2050

<table>
<thead>
<tr>
<th>GREEN</th>
<th>Blue shortage &lt;1000m³/p/yr</th>
<th>Green freedom &gt;1300m³/p/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLUE</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td></td>
<td>Iran, Pak, Jordan Eg, Eth, India, China</td>
<td>Kyrg, Czeckosl, Les, S Afr</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BLUE</th>
<th>Blue freedom &gt;1000m³/p/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>c</td>
</tr>
<tr>
<td></td>
<td>Jap, Bangl, N+SKor, Nga, To,</td>
</tr>
</tbody>
</table>

### Some policy implications

<table>
<thead>
<tr>
<th>GREEN</th>
<th>Blue shortage &lt;1000m³/p/yr</th>
<th>Green freedom &gt;1300m³/p/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLUE</td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td></td>
<td>46% of world pop</td>
<td>14% of world pop</td>
</tr>
<tr>
<td></td>
<td>• horizontal expansion</td>
<td>• upgrading rainfed agric/ rainwater harvesting</td>
</tr>
<tr>
<td></td>
<td>• food import</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• radical water productivity increase</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BLUE</th>
<th>Blue freedom &gt;1000m³/p/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>c</td>
</tr>
<tr>
<td></td>
<td>21% of world pop</td>
</tr>
<tr>
<td></td>
<td>• irrigation expansion</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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4. New irrigation concepts for the 21st century

Source: Dalin et al. (PNAS, 109:16, 2012)
Agricultural drought risks can be insured against:

• Considered a systemic risk (expensive reinsurance)

• Needs subsidies (private sector, reluctant)

• Technically, more difficult than single-peril insurance (Hailstorm)
Agricultural drought risks can be insured against:

- Single peril insurance
- Yield insurance (multiperil insurance)
- Index insurance
  - Rainfall insurance
  - Satellite insurance
5. The Role of insurance

• Problems related to asymmetric information:
  – Due to the differing ability of agents and principal to discern the agents’ risks because of costly monitoring
    • AGENTS: FARMERS/BORROWERS
    • PRINCIPAL:
      – INSURANCE COMPANIES
      – THE GOVERNMENT
      – Banks
  – Two classical problems
5. The Role of insurance

No clear evidence of moral hazard problems in agricultural insurance, especially when:

– With records of individual farmers
– Index insurance (weather derivatives)
– With deductibles
– With bonus-malus
– With low coverages

But, abundant evidence of moral hazard exists in the area of ‘rural banking’ (especially in cases of public agencies)
5. The Role of insurance

- Two classical problems:
  - **Adverse selection**: Inability of the insurer to separate low-risk from high-risk agents.

Actuarially Fair premia:
- Low-risk = 15€/ha
- High-risk = 35€/ha
- The whole Area = 25€/ha

Loss ratios > 1

Only High-risk agents Purchase insurance
5. The Role of insurance

Problems related to incomplete markets:

– Market-based Agricultural insurance is extremely limited

– Lack of collateral makes borrowing expensive or impossible (problems of rural banking)

– Forward contracting is very scarce

– Poor quality-graded and standardisation imposes in situ inspection of harvests
Thank you

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