Measuring number of people affected and economic loss due to agricultural droughts – Examples from Ukraine and South Africa

Yvonne Walz, Karen Dall, Annika Min
Background and Motivation

Agricultural drought

- 23% of loss and damage due to disasters attributed to agricultural sector (FAO, 2017)
- Drought: 84% of loss and damage due to drought hits agriculture (FAO, 2017)

→ Agriculture: highly vulnerable to disasters; but key economic factor and basis for livelihoods

Sendai Framework

- Shift from disaster management to disaster RISK management
- Monitoring progress in disaster risk reduction

→ Need for science-based information and knowledge
→ Need to overcome the lack of data readiness and calculate reference base (UNISDR, 2017)

EvIDENz project

EvIDENz = Earth Observation based information products for drought risk reduction on the national level

Key objectives of EvIDENz

1.) Assessment of selected targets of the Sendai Framework
2.) Understanding drought risk

Case study examples

Selected Sendai targets

Affected people/
global population
2020-2030 Average << 2005-2015 Average

Economic loss/
global GDP
2030 Ratio << 2015 Ratio

Partners:

Affiliated partners:
EvIDENz approach

**Objective I: Assessment of Sendai targets**

- **HAZARD**
  - Drought hazard classification

- **EXPOSED ELEMENTS**
  - People, land, assets

- **VULNERABILITY**
  - Characteristics of people, land, assets

**Sendai indicators:** B5, C2

**Sendai Framework Targets**

- **Affected people/global population**
  - 2020-2030 Average < 2005-2015 Average

- **Economic loss/global GDP**
  - 2030 Ratio < 2015 Ratio

**Objective II: Understanding risk**

Relying on open, accessible data sets that are representative for the national level!
Assessment of Sendai Targets

Target B: People Affected

B-5: Population with livelihoods were disrupted, destroyed due to drought

Target C: Economic Loss

C-2: Direct agricultural loss due to drought

South Africa

Eastern Cape Province

Ukraine

Kiev Oblast
Computation of Sendai indicators

Affected people:
- Global population
  - 2020-2030 Average << 2005-2015 Average

Economic loss:
- Global GDP
  - 2030 Ratio << 2015 Ratio

Technical Guidance for Monitoring and Reporting on Progress in Achieving the Global Targets of the Sendai Framework for Disaster Risk Reduction

Collection of Technical Notes on Data and Methodology

November 2017

The United Nations Office for Disaster Risk Reduction

Indicators measured for Target B

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B5</strong></td>
<td>Number of people whose livelihoods were disrupted or destroyed, attributed to disasters°</td>
</tr>
<tr>
<td><strong>B5a</strong></td>
<td>hectares of crops affected (C2Cₐ) * average workers per hectare</td>
</tr>
<tr>
<td><strong>B5b</strong></td>
<td>livestock lost (C2Lₐ) * average workers per livestock</td>
</tr>
<tr>
<td><strong>B5c</strong></td>
<td>sum of productive assets and infrastructure** such as Industrial, Commercial, Services, etc. ** facilities affected (C3ₐ and C5ₐ) * average workers per facility and infrastructure</td>
</tr>
</tbody>
</table>

° directly measured in situ, or using a nationally defined methodology
**such as Industrial, Commercial, Services, etc.
### Indicators measured for Target C

#### Economic loss/

**global GDP**

2030 Ratio $\gg$ 2015 Ratio

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td><strong>C2C</strong></td>
<td>Direct crop loss</td>
</tr>
<tr>
<td><strong>C2L</strong></td>
<td>Direct livestock loss</td>
</tr>
<tr>
<td><strong>C2FO</strong></td>
<td>Direct forestry loss</td>
</tr>
<tr>
<td><strong>C2A</strong></td>
<td>Direct aquaculture loss</td>
</tr>
<tr>
<td><strong>C2FI</strong></td>
<td>Direct fishery loss</td>
</tr>
</tbody>
</table>

*directly measured in situ, or using a nationally defined methodology*

**such as Industrial, Commercial, Services, etc.**
Processing chain: Economic loss due to affected maize in Kyiv oblast in Ukraine (I)

Hazard Severity Map

Crop Specific Severity Map

Drought Hazard Classification
- no drought
- damaged
- destroyed

Land Cover/Land Use Map
- artificial
- cropland
- forest
- grassland
- bare land
- water

provided by ZFL

provided by N. Kussul, NASU-SSAU

Drought Hazard Classification (Cropland)
- no drought
- damaged
- destroyed
- other LC
- water
Processing chain: Economic loss due to affected maize in Kyiv oblast in Ukraine (II)

Hazard Severity Map 2015 H0-H2 → Crop Masks 2015 Overlay → Administrative Boundaries of Rayons → Extract Statistics for Rayons → Crop specific Land in H0-H2 per Rayon → Hazard Severity Map

Rayon: Makarivskyi
not affected = 2,450 ha
damaged = 4,200 ha

Rayon: Teetivskyi
not affected = 6,800 ha
damaged = 5,100 ha

Difference between expected and actual value of crop production in non-fully affected harvested area

\[ p_{ij,t-1} \cdot \Delta y_{ij,t} \cdot ha_{ij,t} \cdot 1(\Delta y_{ij,t} > 0) \]

\[ \text{Price}_{\text{pre-disaster}} \times (\text{expected yield (Y}_{\text{max}}) - \text{actual yield (Y}_{2015})) \times \text{number of hectares} \]

\[ \text{selling consumer price}^1 \times (\text{Y}_{\text{max,2004-2015}} - \text{Y}_{2015}) \times \text{ha}_{H1} \]

\[ 1 \text{ http://www.agricistrade.eu/statistics} \]
Processing chain: People affected by crops damaged or destroyed in South Africa

\[ B5a = \text{hectares of crops affected} \times \text{average workers per hectare} \]

- Households involved in crop production \times \text{number of people per household} = \text{number of crop-dependent people}

- \text{number of crop-dependent people} \div \text{hectares of cropland} = \text{density of crop-dependent population per hectare of cropland}

- \text{density of crop-dependent population per hectare of cropland} \times \text{hectares of cropland in hazard classes (from C2-C)} = \text{hectares of crops affected}
Opportunities

Processing chain based on remote sensing data in combination with socio-economic data:
- Supports the retrospective assessment of indicators (relevant for reference base).
- Provides a spatial explicit, disaggregated, objective information as cross-reference.
- Documentation and dissemination as „recommended practices“ via UN-SPIDER knowledge portal allows to reproduce procedure for any region.

Challenges
- Defining thresholds to determine not affected, not fully affected (damaged) and fully affected (destroyed).
- Reduce uncertainties in measuring indicators.
Why vulnerability matters?
Why vulnerability matters?

Vulnerability Index Map

Source: Jordaan et al., 2017
Why vulnerability matters?

- Support decision making on the activation of safety nets
- Understanding risk through characteristics of vulnerability and identifying entry points for pro-active risk reduction strategies and adaptation.
- Identifying current and potential hotspots of vulnerability to drought hazards and in this relation identify hotspots of impacts.
- Tracking changes in vulnerability and monitoring and evaluation of prevention and adaptation efforts.

Source: Jordaan et al., 2017
Outlook: Does vulnerability impact Sendai indicator values?

Legend:
- Very low vulnerability
- Low vulnerability
- Moderate vulnerability
- High vulnerability
- Very high vulnerability

HAZARD
- Drought hazard index

EXPOSED ELEMENTS
- People, land, assets

SUSCEPTIBILITY

COPING CAPACITY

Sendai indicators: B5, C2

Sendai Framework Targets

Risk to agricultural assets and livelihoods

UNU-EHS
Institute for Environment and Human Security
Thank you very much for your attention

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Understanding risk – Measuring vulnerability to drought

South Africa
Eastern Cape Province

Susceptibility index

Capacity index

Vulnerability index

Ukraine
Kiev Oblast

Susceptibility index

Capacity index

Vulnerability index
## Indicators measured for Target C

**Economic loss/ global GDP**  
2030 Ratio << 2015 Ratio

### C2 Direct agricultural loss attributed to disasters

#### C2C direct crop loss

<table>
<thead>
<tr>
<th>Loss of annual crop stocks</th>
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<tr>
<td>Loss of perennial crop stocks</td>
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</table>

**Annual crop production loss** = difference between expected and actual value of crop production in non-fully affected harvested area in disaster year + pre-disaster value of destroyed crops in fully-affected areas + Short-run post-disaster maintenance costs (lump sum of expenses used to temporarily sustain production activities immediately post-disaster)

<table>
<thead>
<tr>
<th>Perennial crop production loss</th>
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<tbody>
<tr>
<td>Crop assets lost</td>
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