Empirical Forecasting of Slow-Onset Disasters for Improved Emergency Response

An Application to Kenya’s Arid Lands

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Objective

• Develop an empirical forecasting model to predict the human impact of slow-onset disasters for early warning.

Motivation

• Increasing frequency of humanitarian crises call for efficient and practical methods of emergency needs assessment.
Geographic Focus: Kenya’s Arid North

- Highly vulnerable to recurring shocks such as droughts and floods
- Largely populated by nomadic pastoralists

Data

- Arid Lands Resource Management Project
  - Livestock Variables
  - Child Nutritional Data
- Global Livestock CRSP (LEWS/LINKS)
  - Climate Variables
Sample Sites

Turkana (20)

Marsabit (9)

Baringo (12)

Samburu (14)
Severe Child Malnutrition and Food Crisis

- Forecasting food crisis requires a suitable indicator variable
- Child anthropometric measures of acute malnutrition typically used
- **Mid-Upper Arm Circumference (MUAC)**
  - *Superior predictor of child mortality*
- A MUAC Z-Score of -2 often used as an indicator of “severe wasting”
- **Our Indicator of Food Crisis:** Whenever 20% or more of children are suffering severe wasting.
Early Warning: Forecasting Food Crisis

• Effective response requires early warning

• Two-forecasting models:
  – 1) One Month Forecast: Better accuracy, less response time
  – 2) Three-Month Forecast: Less accurate, more response time
Forecast Results

Fraction of Children Experiencing “Severe Wasting”

- Frequent experience of food crisis
- Forecasts trace actual values quite well and improve with time
- Difference between one-month and three-month forecast accuracy not considerable
Making Practical Use of the Forecasts

• Example: Food Security Organization
  – Predictions in the form of intensity of severe wasting

• Decision making parameters
  – Minimum likelihood of food crisis required before initiating emergency response
  – Defining a “correct decision”:
    • Initiating response when there is actually a food crisis
    • No response when there is no food crisis

• Forecast Performance
  – Fraction of correct decisions
### Forecast Performance

<table>
<thead>
<tr>
<th>Forecast Horizon</th>
<th>Confidence Threshold</th>
<th>Fraction of Correct Decisions</th>
<th>Fraction of Errors that are Type 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>75%</td>
<td>66%</td>
<td>50%</td>
</tr>
<tr>
<td>One Month</td>
<td>0.777</td>
<td>0.786</td>
<td>0.785</td>
</tr>
<tr>
<td>Three Month</td>
<td>0.753</td>
<td>0.756</td>
<td>0.758</td>
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**Type 1 Errors:** Failing to respond when a famine actually occurs.
Conclusions/Policy Implications

• Developed an empirical forecasting model that can predict with reasonable accuracy the expected human impact of slow onset shocks such as drought.

• Model is based on a non-restrictive set of variables making it quite cost effective

• Model can be easily and regularly updated with new information that should continuously increase its forecast performance

• Invaluable for early warning and emergency response to food crisis
Acknowledgements

• Arid Lands Research Management Project

• Global Livestock CRSP
  – Pastoral Risk Management (PARIMA)
  – Livestock Early Warning System (LEWS)
  – Livestock Information and Knowledge System (LINKS)

• International Livestock Research Institute

• World Food Program