Improved early warning of food insecurity: Integrating forecasts based on machine learning and MUAC data into Kenya's National Drought Monitoring Authority

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Jameel Observatory stocktaking webinar on enhancing forecasting and earth observation data and applications for drylands of the Horn of Africa, 20 January 2026

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JAMEEL OBSERVATORY FOR FOOD SECURITY EARLY ACTION

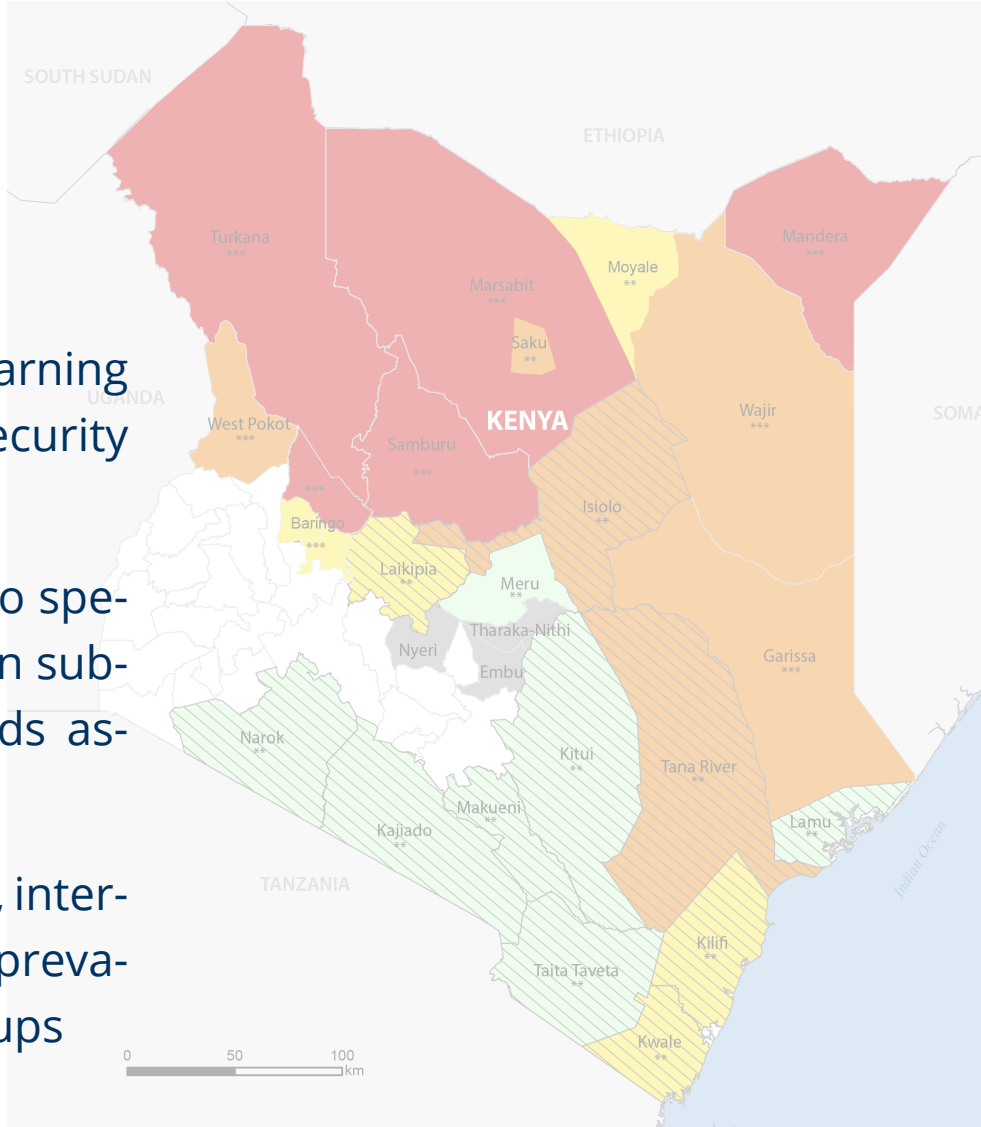
Berkeley UNIVERSITY OF CALIFORNIA

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Problem Framing

- Current drought monitoring and early warning relies, officially, on the Integrated Food Security Phase Classification (IPC)
- The IPC has low spatial granularity and no specific information on vulnerable population subgroups -> Difficult to make precise needs assessments of timely relief action
- **Partnership's objective**: bring a new tool, internal to the NDMA, to forecast the hunger prevalence trend of vulnerable population groups



Source: IPC, 2024

Our partnership

- 4 years working together developing the EW tool; model now published in a high impact journal (PNAS)
- Focus on fully utilizing NDMA's MUAC data: target areas with high hunger prevalence among U5 children
- Project funded by research partners and private industry: Jameel Observatory, Google Inc.

PNAS RESEARCH ARTICLE | ECONOMIC SCIENCES SUSTAINABILITY SCIENCE OPEN ACCESS

High-frequency monitoring enables machine learning–based forecasting of acute child malnutrition for early warning

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Affiliations are included on p. 11.

Contributed by Christopher B. Barrett; received August 9, 2024; accepted April 28, 2025; reviewed by Kathy Baylis, Thomas Heckelei, and Yiqun Xie

The number of acutely food insecure people worldwide has doubled since 2017, increasing demand for early warning systems (EWS) that can predict food emergencies. Advances in computational methods, and the growing availability of near-real time remote sensing data, suggest that big data approaches might help meet this need. But such models have thus far exhibited low predictive skill with respect to subpopulation-level acute malnutrition indicators. We explore whether updating training data with high frequency monitoring of the predictand can help improve machine learning models' predictive performance with respect to child acute malnutrition by directly learning the dynamic determinants of rapidly evolving acute malnutrition crises. We combine supervised machine learning methods and remotely sensed feature sets with time series child anthropometric data from EWS' sentinel sites to generate accurate forecasts of acute malnutrition at operationally meaningful time horizons. These advances can enhance intertemporal and geographic targeting of humanitarian response to impending food emergencies that otherwise have unacceptably high case fatality rates.

food security | food crises | humanitarian response | nonstationarity | resilience

Increasingly frequent and severe shocks—whether extreme weather events such as droughts, or socioeconomic ones like conflict or price spikes—have precipitated growing food emergencies worldwide. In 2022, an estimated 349 million people experienced acute food insecurity, more than double the 2017 figure, and the largest number recorded in over 70 y (1). In the absence of timely, well-targeted, responses to such emergencies, people become severely malnourished and more vulnerable to infectious disease, leading to avoidable death. Young children (under 60 mo of age, U5) are especially vulnerable to temporary disruptions in access to healthy foods. Malnourished children lose weight rapidly, resulting in severe acute malnutrition (SAM), or severe wasting, the most serious manifestation of acute malnutrition. SAM is associated with 45% of all worldwide deaths of children under 5 y of age (2, 3). Anthropometric indicators, such as weight-for-height, are the gold standard for establishing SAM, especially among U5 children and at subnational levels (4).

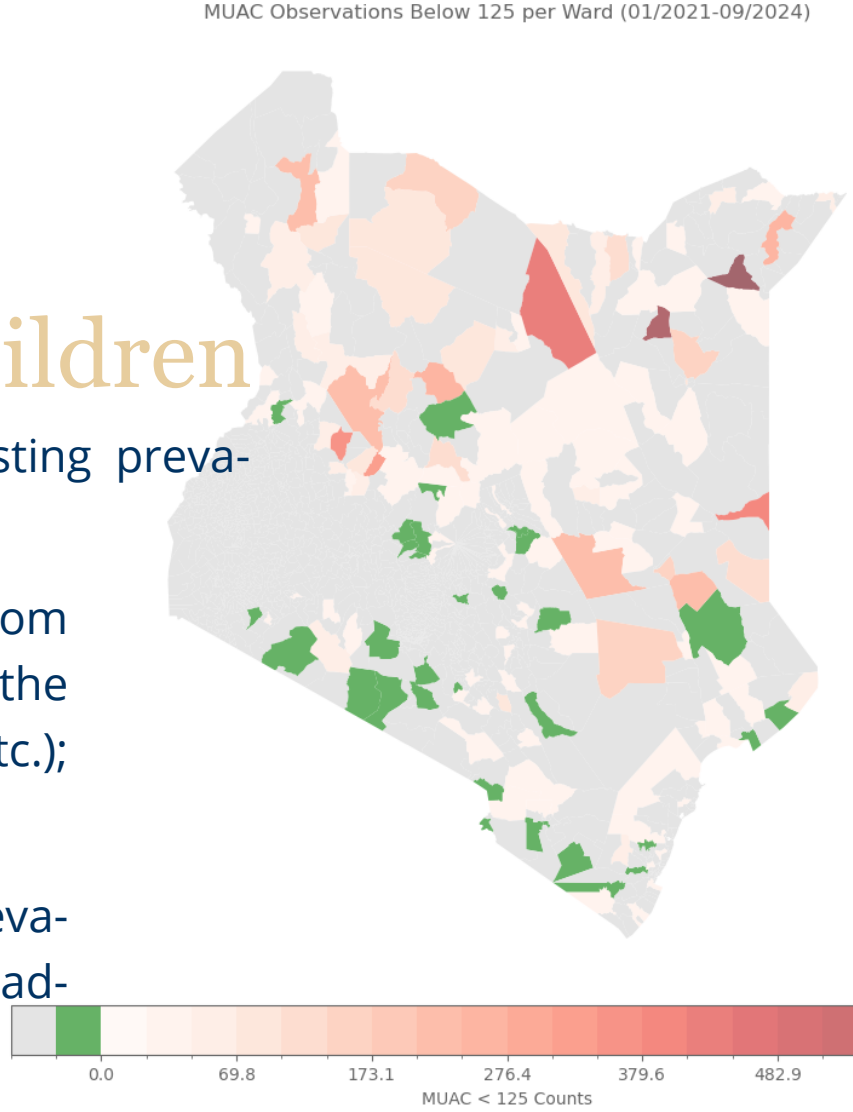
Humanitarian and governmental agencies have invested heavily in early warning

Significance

As the number and share of people suffering from food insecurity worldwide has risen over the past decade, the humanitarian response community increasingly seeks advances in early warning systems to target populations who need food assistance. Advances in Earth Observation data and in machine learning have excited interest in their potential to help with early warning and geographic targeting of food assistance. To date, however, the predictive performance of such models with respect to child acute malnutrition has disappointed. We show how predictive skill and predictors vary over time and demonstrate the high value of monthly monitoring of child anthropometry in sentinel sites. With such data it is feasible to generate reasonably accurate forecasts at time horizons of 6 mo.

Predicting food insecurity among U5 children

- Machine learning based prediction of wasting prevalence at the ward level (admin 4)
- Predictors are geospatial variables mostly from remote sensing, based on the ones that the NDMA already monitors (i.e. rainfall, NDVI, etc.); plus lags of dependent variable
- Forecasts follow the evolution in wasting prevalence fluctuations up to three months in advance at the individual ward level



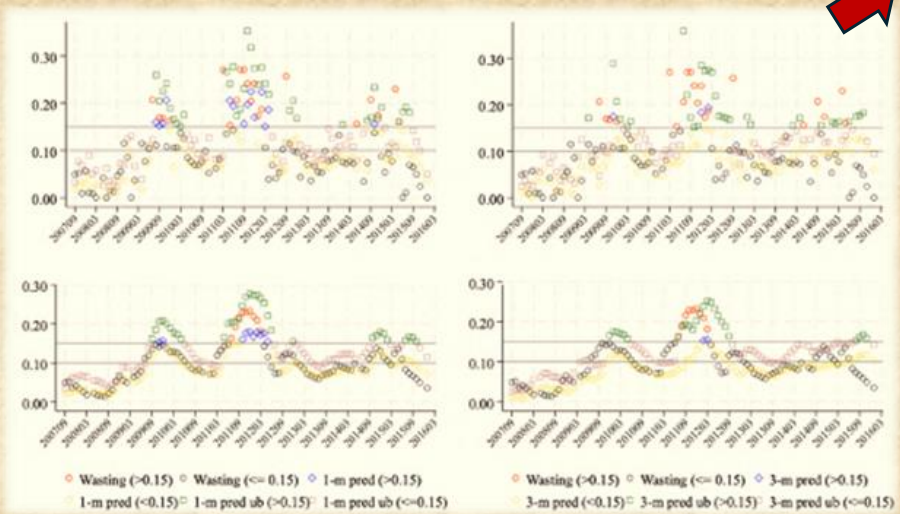
Early warning tool diagram



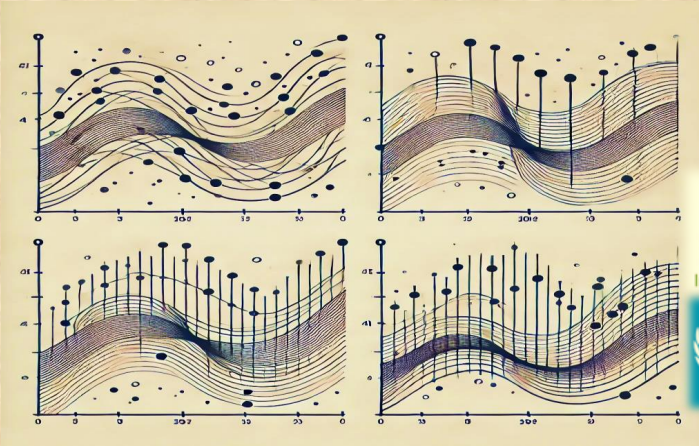
Middle Upper Arm Circumference (MUAC)
+
Geospatial Data



Machine Learning Model



Up to 3-month forecasts of wasting prevalence at the community level



REPUBLIC OF KENYA
MINISTRY OF HEALTH
NDMA
OXFAM International
USAID

Dashboard incorporates results monthly, shared with key stakeholders



Trigger

Aid sent through household-level social safety net programs via mobile money



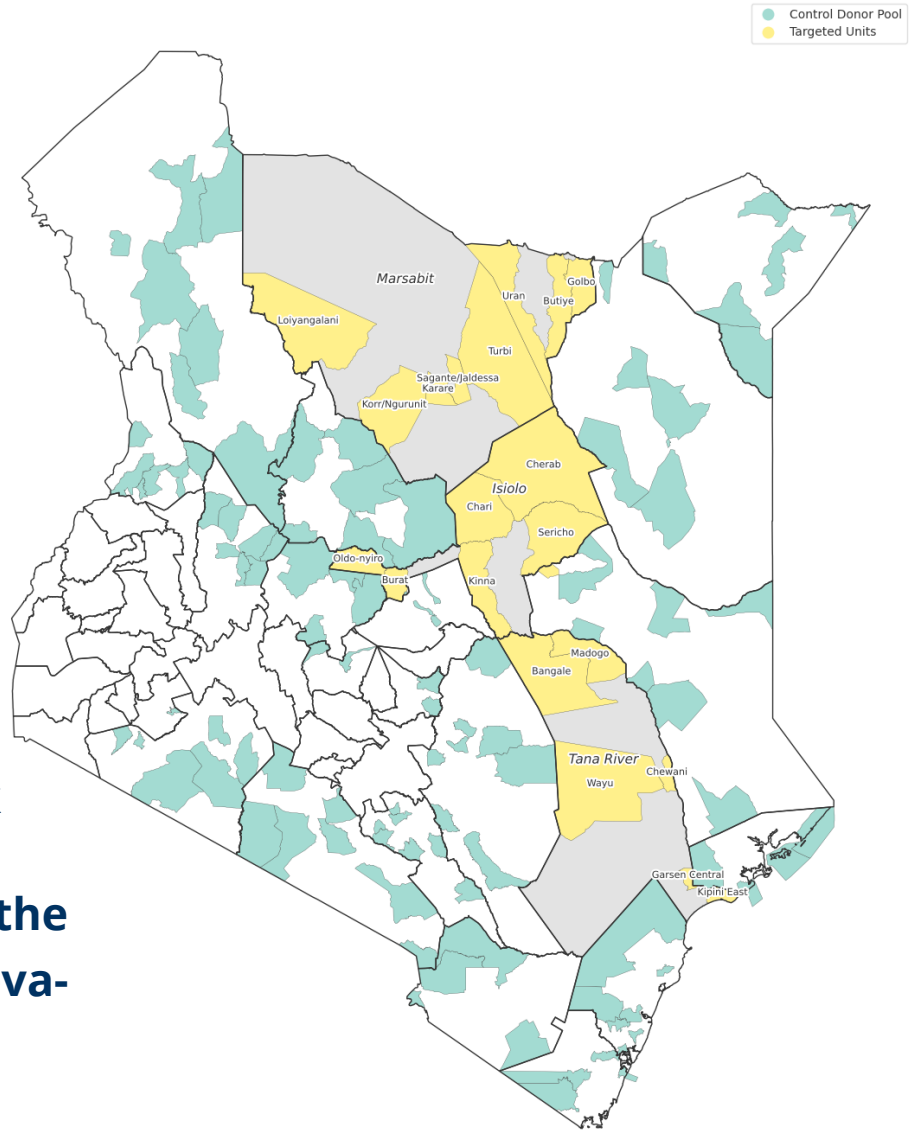
Dashboard with results that can be monitored monthly

Trend based monitoring, with map overview and individual ward lookup

Check out the live dashboard at: **Wasting Prediction Dashboard**.

Piloting under impact evaluation

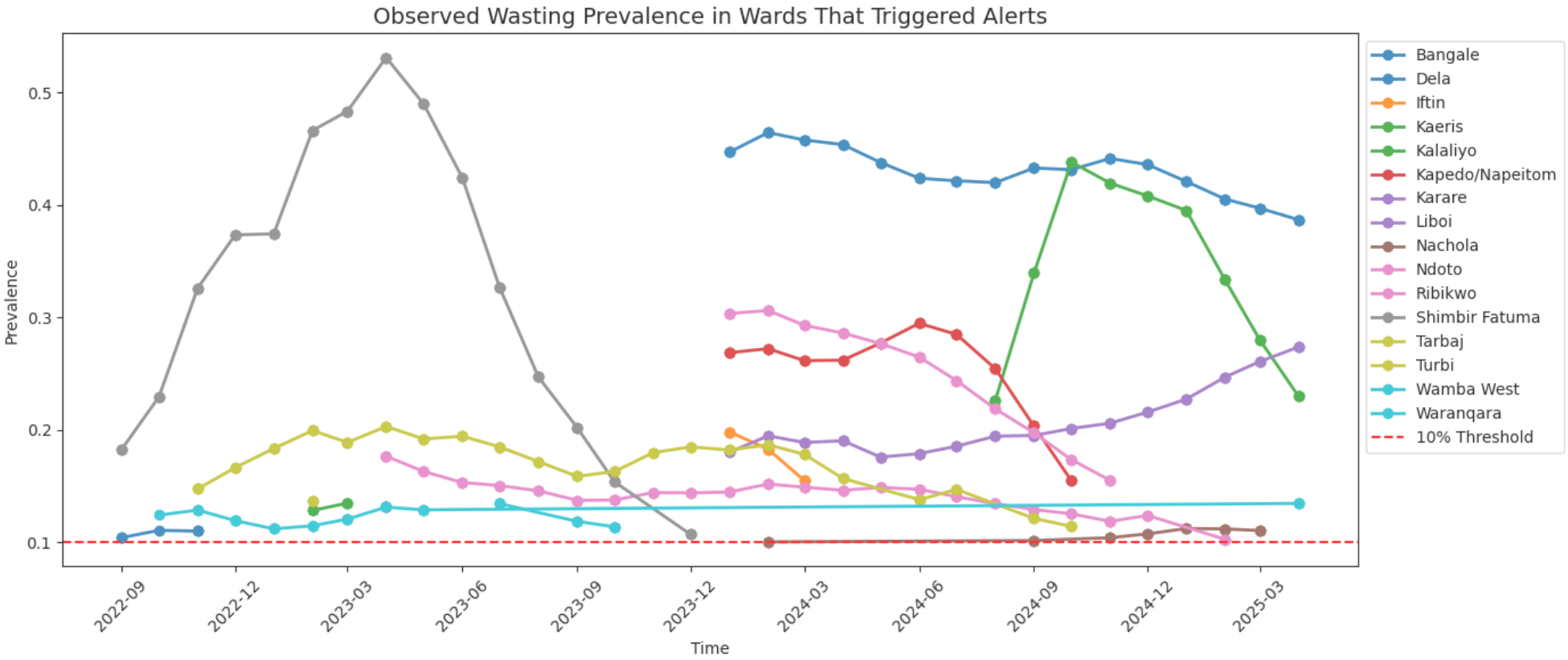
- Piloting the tool in three counties (Marsabit, Tana River, Isiolo) from January 2026 for at least 6 months
- Piloting under impact evaluation framework
- Main research question: **does the use of the EW and triggering tool reduce wasting prevalence in the pilot wards versus the rest?**



Piloting under impact evaluation: trigger selection

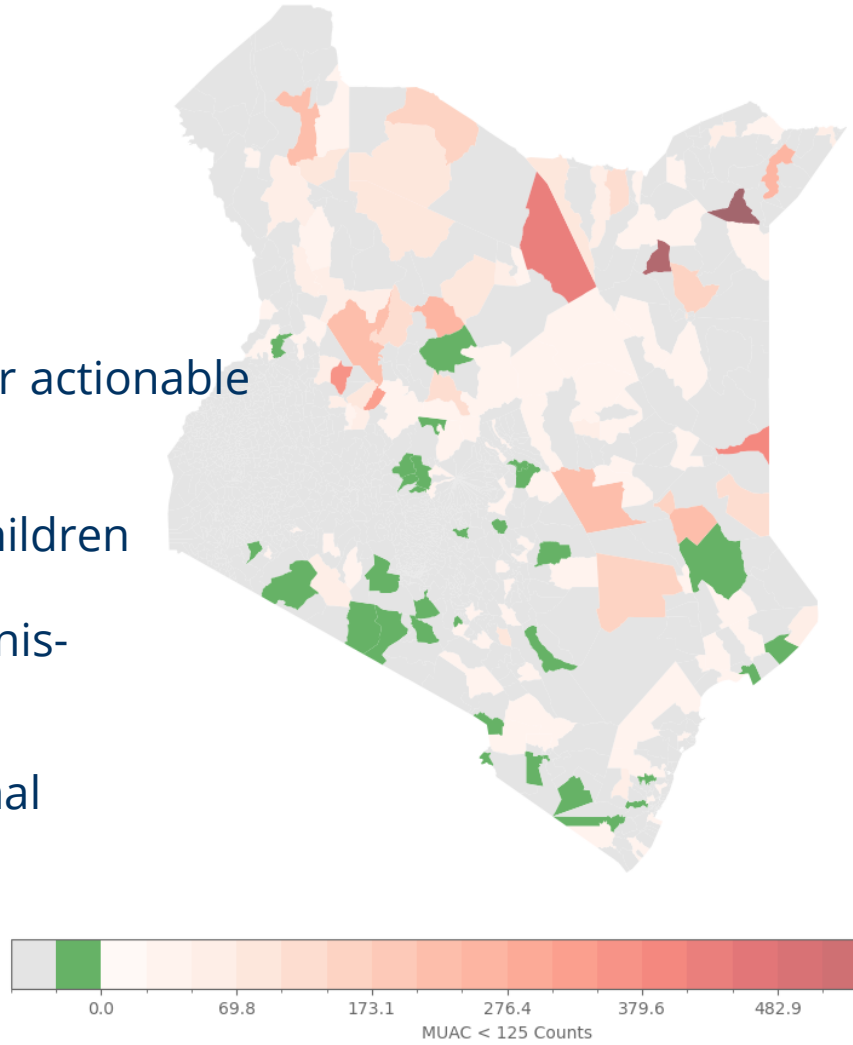
- Testing a triggering system based on observed and forecasted wasting prevalence
- Two criteria, based on (i) forecasting performance and (ii) WHO thresholds of public health significance:
  1. Wasting prevalence $\geq 10\%$
  2. Predicted 3-month trend is stable or increasing
- Tested on historical data: does it detect sustained high-prevalence episodes?

Hunger episodes to be avoided by anticipatory action under NDMA's hunger safety net program (HSNP)



Key differences with current system

- Model based forecasts, focus on a particular actionable indicator (wasting prevalence)
- Focus on targeting vulnerable groups: U5 children
- Information delivered at geographic administrative divisions (Ward)
- Monthly updates of the tool, not just seasonal
- Actionable trigger based on a measurable, specific indicator



Thank you!