Webinar on Near-Real-Time Monitoring of Food Crisis Risk Factors: State of Knowledge and Future Prospects

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Food Security Portal

Summary

Food security and nutrition security, particularly in low-income countries, continue to face significant challenges - from volatile food prices, climate change-driven shocks, and conflict to pandemics and economic downturns. A number of research efforts exist around the world to allow near-real-time monitoring of these and other risk factors that drive food crises. This work includes monitoring production-related information, climate and conflict data, price information, and other factors in order to identify the likelihood of acute food insecurity and help policy makers enact timely policy responses.

This webinar focused on benchmarking progress in near-real-time monitoring by highlighting existing efforts and discussing future prospects of this area of work. Arif Husain (WFP), Laura Glaeser (FEWS NET), and Mario Zappacosta (FAO Global Information and Early Warning System – GIEWS) shared their respective institutions' work on near-real-time monitoring. Daniel Maxwell (Tufts University), Chris Barrett (Cornell University), Kathy Baylis (University of Illinois), and David Laborde (IFPRI) provided a research perspective, sharing some recent efforts on using near-real-time monitoring to improve the ability to assess and predict food crisis risk. The webinar clarified the role of near real-time monitoring in existing early warning systems, highlighted several existing monitoring platforms and tools, and shared some of the latest research in improving the use of real-time monitoring for food crisis assessment and prediction.

Clarifying the role of real-time monitoring

Daniel Maxwell of Tufts University laid out a framework for understanding the role of real-time monitoring in addressing food crisis risk. Real-time monitoring involves information that tracks actual developments and can be used to update assumptions, validate or change projections, and adjust programming quickly. Current status classifications such as the Integrated Phase Classification (IPC) and Cadre Harmonisé (CH) determine the numbers of people in certain classifications based on outcomes that have already occurred. Real-time monitoring complements current status classifications by providing higher frequency information that can inform projections. Having clarified the concept of real-time monitoring with respect to current status assessments, Daniel Maxwell highlighted the importance of looking into how well real-time monitoring informs the updating of projections and the validation of current status assessments.

Near-Real-Time Monitoring Platforms and Tools

The webinar highlighted several platforms and tools that seek to make data on food crisis risk clear and actionable. Arif Husain of WFP presented **WFP's Hunger Map**, which is a dashboard that brings together data on hazards, conflict, undernourishment, current food consumption, vegetation, rainfall, and IPC/CH numbers.

Laura Glaeser highlighted **FEWS NET's** work on developing a global dashboard for hotspot identification that models the likely impacts of shocks on the ability of people to meet their food needs. This complements FEWS NET's work on producing monthly statements on food needs. FEWS NET utilizes monitors on the ground who gather information on retail prices for key commodities, informal cross-border trade flows, casual labor wage rates, etc. They also use remote sensing and earth observation data from NOA, NASA and USGS to gauge area planted.

Mario Zappacosta presented on **FAO** tools that monitor supply and demand dynamics. The ***Agricultural Stress Index (ASI)*** is an indicator for the early identification of cropland areas with high likelihood to be affected by drought. ***GIEWS Food Price Monitoring Analysis (FPMA)*** monitors domestic and international prices. It provides early warnings on abnormally high domestic prices based upon price anomalies while controlling for seasonality of prices. FAO's ***Food Insecurity Experience Scale (FIES)*** measures the severity of food insecurity experienced by individuals or households based on direct interviews. As a result, FIES can serve as an outcome indicator when monitoring the impact of food crises on food access at individual or household level.

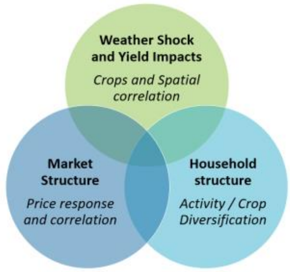
Promising near real-time monitoring research

Large, **nationally representative surveys** such as Living Standards Measurement Study (LSMS) and Demographic and Health Surveys (DHS) give an accurate read on several development indicators, but these are expensive exercises and are not designed to provide information on quickly changing situations such as acute food insecurity. The webinar showcased two areas of research related to using **machine learning to predict food insecurity**, with the aim of predictions that are reasonably accurate in terms of coming close to DHS and LSMS. As clarified by the research presented during the webinar, LSMS and DHS serve as *ground truthing* for models that seek to provide insight on acute food insecurity and other quickly changing dynamics.

Chris Barrett of Cornell University and Kathy Baylis of University of Illinois at Urbana-Champaign shared separate areas of research on this topic. A number of underlying characteristics and considerations of this area of research were identified:

- Using machine learning to predict slower-moving phenomena such as asset poverty is simpler and has been explored in the literature. Prediction of fast-moving situations such as acute food insecurity is more challenging, but there are advances in this regard.
- Initial findings show promise for models that use machine learning as a complement to other existing systems.
- Data such as geography, vegetative growth, and especially market price data, can greatly support models' predictive power.
- The next steps for the research are to improve further models' predictive power using secondary data sources (i.e. satellite imagery, etc.) as inputs.

David Laborde of IFPRI underscored that it is important to consider how markets and economic drivers are affected by shocks as well, since households affected by the drivers of food crises do not operate in isolation but are connected through markets. He stressed that an effective response to shocks needs to take into account the drivers of vulnerability. This is about more than availability of food and monitoring production; access, i.e. income, matters greatly. David Laborde highlighted research being undertaken with IFPRI and Global Parametrics connecting the impact of shocks on prices, the market response, and the downstream impact on income and food security. The aim of such a model is to provide forecasting information so that payments can be triggered to governments before a crisis is widespread.



Visual from David Laborde's (IFPRI) presentation

<u>Follow-up Discussion Post-Webinar</u>

The webinar generated a number of questions from participants. Some of the questions and answers are outlined below.

***Q**: We know that the LSMS and other big survey dataset have large inaccuracies and much missing information. So how one can make "near real" predication from those datasets?*

***A** (Kathy Baylis): In our most recent work, we're currently just using the LSMS as the 'ground truth' for measures of household food security. We could also compare these against DHS or any other data source on food security. The predictions themselves are now coming purely from remotely sensed data, and secondary price information. Your point is well taken that any non-classical measurement error in the LSMS measures of food security are being embedded in our trained model, so it would be worthwhile to think about testing it against other food security data sources.*

***Q**: Are these model robust to the type of events that the COVID epidemic will trigger? COVID will not change rainfall or other geo-based information.*

***A** (Kathy Baylis): Speaking for our model, while we get at food access a bit by looking at stock-outs and food prices, we don't currently capture (non-agricultural) income shocks. I think trying to push this model to incorporate threats to income would be very useful.*

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***Q**: Asset poverty prediction may be tolerably okay for rural versus urban geo settings. How about for urban slums?*

***A** (Kathy Baylis): Thank you - that's a very good point, and something we need to explore. Some recent work on image interpretation is looking at more detailed assets from granular imagery which might be* *more helpful for slums, but beyond things like roof or road type, we're probably not capturing much variation for informal urban settlements.*

***Q**: It looks like a large amount of data in very short time periods is required. Is this possible for most low-income countries with very little tax base resulting in insufficient funds to effectively collect the desired data in the timely manner required for real time monitoring? If the country does not have the financial resources to collect the desired data, what are they submitting? Will this be mostly armchair estimates instead of real data? If so how accurate and reliable will this be? I think most food crisis concerns actually occur over a relatively large time frame, thus is it really necessary for real time monitoring, particularly if the concern mention above on data quality is real?*

***A** (Kathy Baylis): From our side, that's very much why we wanted to start experimenting with what we could do with only remotely-sensed data, which would lower the burden on country governments. I don't pretend it will be able to capture everything, but it is suggestive that it can already capture a fair bit of the variation in food security.*

***A** (Mario Zappacosta): The FAO Agricultural Stress Index (ASI) is a free access and open source system. It can be accessed through the FAO GIEWS Earth Observation website at http://www.fao.org/giews/earthobservation/asis/index_1.jsp?lang=en, together with other weather-related indicators. FAO supports the installation of ASI at country level with specific calibration of the main parameters (crop masks, crop types, sowing dates, sensitivity of crop to drought at different phenological stages,...). It is always recommended that countries provide technical support for ground truthing and calibration of the tool. For national drought monitoring, information based on a 10-days (dekadal) timeframe is adequate to monitor changes in vegetation.*

***A** (Chris Barrett): We only use data already generated, typically at global scale from satellites or by existing platforms (e.g., FAO GIEWS).*

***Q**: Apart from climate, what consideration do all the models give to factors like pest and disease? Can you factor in some consideration regarding pest for specific crop in a specific area or region especially in areas where there are no effective extension services like Somalia. An example is the recent locust outbreak in Somalia.*

***A** (Kathy Baylis): Ideally, in as much as pest outbreaks will be picked up by changes in NDVI (or other vegetative measures), it should be able to capture large-scale pest outbreaks. In as much as pest outbreaks are very spotty (say, not decimating entire fields), it might be trickier. Another potential problem might be invasive plant species that could reduce yield and could be tricky for a generic model to capture.*

***A** (Chris Barrett): A vegetation index such as SIF picks up the impacts that pests and diseases - along with weather, etc. -- are already having on crop growth but they necessarily cannot capture predictable impacts from pests or diseases heading towards an area.*

***A** (Mario Zappacosta): FAO has developed the FAW Monitoring and Early Warning System (FAMEWS), a free mobile application for Android cell phones for the real-time global monitoring of the Fall Armyworm (FAW). This multi-lingual tool allows farmers, communities, extension agents and others to record* *standardized field data (https://play.google.com/store/apps/details?id=org.fao.famews&hl=en_US). Recently, scientists at the National Oceanic and Atmospheric Administration (NOAA) have teamed up with FAO experts and have developed a web application that can be used to monitor the spread of the desert locusts by forecasting where the wind will blow the insects after they take flight.*

***Q**: Who is the intended audience of decision makers for these tools? Have you interacted directly with members of FS clusters in certain countries?*

***A** (Kathy Baylis): We would hope that our model would be useful for decision makers at either a country or regional level, as a supplement to their existing early warning systems. We are just starting to run some of our predictions by decision-makers to get their feedback on where they think our model is hitting or missing the mark, and what form of the output would be most helpful.*

***A** (Mario Zappacosta): Both the Agricultural Stress Index (ASI) and the Food Price Monitoring and Analysis (FPMA) tool by FAO are widely used at country level by technical staff dedicated to monitor food supply and demand and their analyses guide several local actions such as drought mitigation measures, public investments, crop insurance scheme, safety nets.*

***A** (Chris Barrett): The immediate target audience is USAID, the sponsor of the research, and its cooperating agencies. We have been in touch with several food security clusters in Feed the Future countries.*

***Q**: Given restricted movement in areas who have imposed lockdown or strict quarantine, how do you monitor food accessibility?*

***A** (Kathy Baylis): You make an excellent point - other than as it might be reflected in unexpected market outcomes (price fluctuations, stock-outs), we would miss this form of food (in)access.*

***A** (Chris Barrett): Nothing in our models directly captures this. We are in uncharted territory with the pandemic; there simply aren't data available to train these sorts of models just yet.*

***Q**: Most of the tools presented so far are on food supply and sustainability. How about monitoring household access to food in times of lockdown like covid-19, what tools can be used?*

***A** (Kathy Baylis): In an ideal world, one could integrate population movement data from cell phones to capture changes in mobility. I think it would also be useful to think carefully about if and how these types of predictive models could capture large (non-agricultural) income shocks.*

***A** (Chris Barrett): The point of our model is to capture a range of features that affect poverty and malnutrition. Ours is not a supply side model. We are not predicting crop growth or food supply but rather human outcome indicators related to poverty and various malnutrition indicators (stunting, wasting, women's BMI, etc.) that capture access as well as availability, utilization and stability mechanisms in a reduced form design.*

***Q**: Collaboration is fine - all agree in principle. What about collaboration in informing/influencing decision making and action?*

***A** (Kathy Baylis): Very much agreed - ideally this would reach beyond academic/researcher collaboration to linking directly with stakeholders.*

***Q**: Thank you for the great presentations. My question is different presenters are monitoring or predicting different scales. What scales are needed to support policy responses by end users (e.g., country level, vs village vs admin 2)?*

***A** (Kathy Baylis): Presumably one would like to have predictions be as spatially granular as possible to capture very localized food crises. That said, one would ideally like to take food flows within a country into account (so that the predictive model doesn't place too much emphasis on local weather for a non-agricultural region; and takes shocks to the prime growing regions into account in areas that are net-consumers).*

***A** (Mario Zappacosta): It depends. If you need to monitor crop yields or area planted in a given field to provide, for exemple, subsidies per ton or per hectare, it is advisable to use high-resolution images (see EU Anomaly Hotspot of Agricultural Production - ASAP https://mars.jrc.ec.europa.eu/asap/). If you work on a regional agency and need to spot the areas most affected by drought at country level, the use of images at 1 km resolution may be adequate (see FAO ASI http://www.fao.org/giews/earthobservation/asis/index_1.jsp?lang=en).*

***A** (Chris Barrett): Presumably different end users need different spatial and temporal resolution of monitoring/prediction.*

***Q**: How can we use real time monitoring in circumstances where some regions within the same country are experiencing high yields and others low yields. What opportunities exist for collaboration with Kenyan academic institutions.*

***A** (Kathy Baylis): Many of these models primarily look at changes over time within regional agricultural production, and some models place extra weight on areas that are prime growing regions for a country. But you make a very good point that we want to be careful about food flows within a country. Even if an area is not the primary maize growing regions within that country, it could still be decimated if it has a local food supply shortfall or a bad shock to local income.*

***A** (Mario Zappacosta): If area are not homogeneus in terms of yields, it is advisable to zoom at admin level 1 or 2 using high-resolution images (see EU Anomaly Hotspot of Agricultural Production - ASAP https://mars.jrc.ec.europa.eu/asap/).*

***A** (Chris Barrett): Our modeling effort is at the enumeration area scale (typically adm2 or adm3), so expressly addresses intra-national variation across space. Once we have the basic research part complete, we intend to make everything - data, code, training materials - fully available and are happy to work with others who wish to adapt the modeling apparatus.*

***Q**: In the crisis situation, we observe that traditional early warning/food security monitoring indicators like market price is no longer valid - e.g. once prices hit the ceiling, we no longer observe changes, which does not mean that the situation is stabilized, rather the situation is critical. Any good practices to capture this - adjust/change the indicators as well as how you interpret the data?*

***A** (Kathy Baylis): Very true. We also have some metrics for stock-outs and have explored rate of price change, but yes, these will be limited.*

***Q**: Have these tools been used in high income countries? The United States?*

***A** (Kathy Baylis): Ours has not, largely because it focuses on supply-side shocks (and resulting prices), whereas food insecurity in developed countries primarily results from non-agricultural income shocks. We also anticipate that food supply systems in developed countries are better integrated, mitigating some severe local price spikes, so that local prices would likely be less informative.*

***Q**: Apart from collaboration, can agencies also share these tools in open source mode for people to deploy in different contexts also?*

***A** (Mario Zappacosta): Both the Agricultural Stress Index (ASI) and the Food Price Monitoring and Analysis (FPMA) tool by FAO are available online free of charge. Upon request, FAO can support the implementation/customization of both instruments at country level.*

***A** (Chris Barrett): That is the idea behind our reliance on publicly available data. We will make our data, code and findings publicly available for people to adapt, replicate, etc.*

***Q**: How can remote sensing help with the food insecurity due to COVID-19?*

***A** (Chris Barrett): We will find out. Nobody knows whether any existing models will accurately predict food insecurity indicators during this pandemic since we haven't observed anything like it before so no models are trained on data from a context with these sorts of mass shutdowns in place.*

***Q**: Food flow analysis shows that networks are both biological and social. How can this be used to improve prediction?*

***A** (Chris Barrett): Data on food flows are not routinely available, especially not in a timely way, at scale, and publicly available (rather than proprietary data from firms). Not necessary and not especially useful for the sort of modeling we're trying to do, relying purely on publicly available data so that the routines can be easily adapted by anyone in open access mode.*