Modeling and forecasting Food Insecurity

October 12

WBG update for IPC ATARI WG meeting
12 October 2023

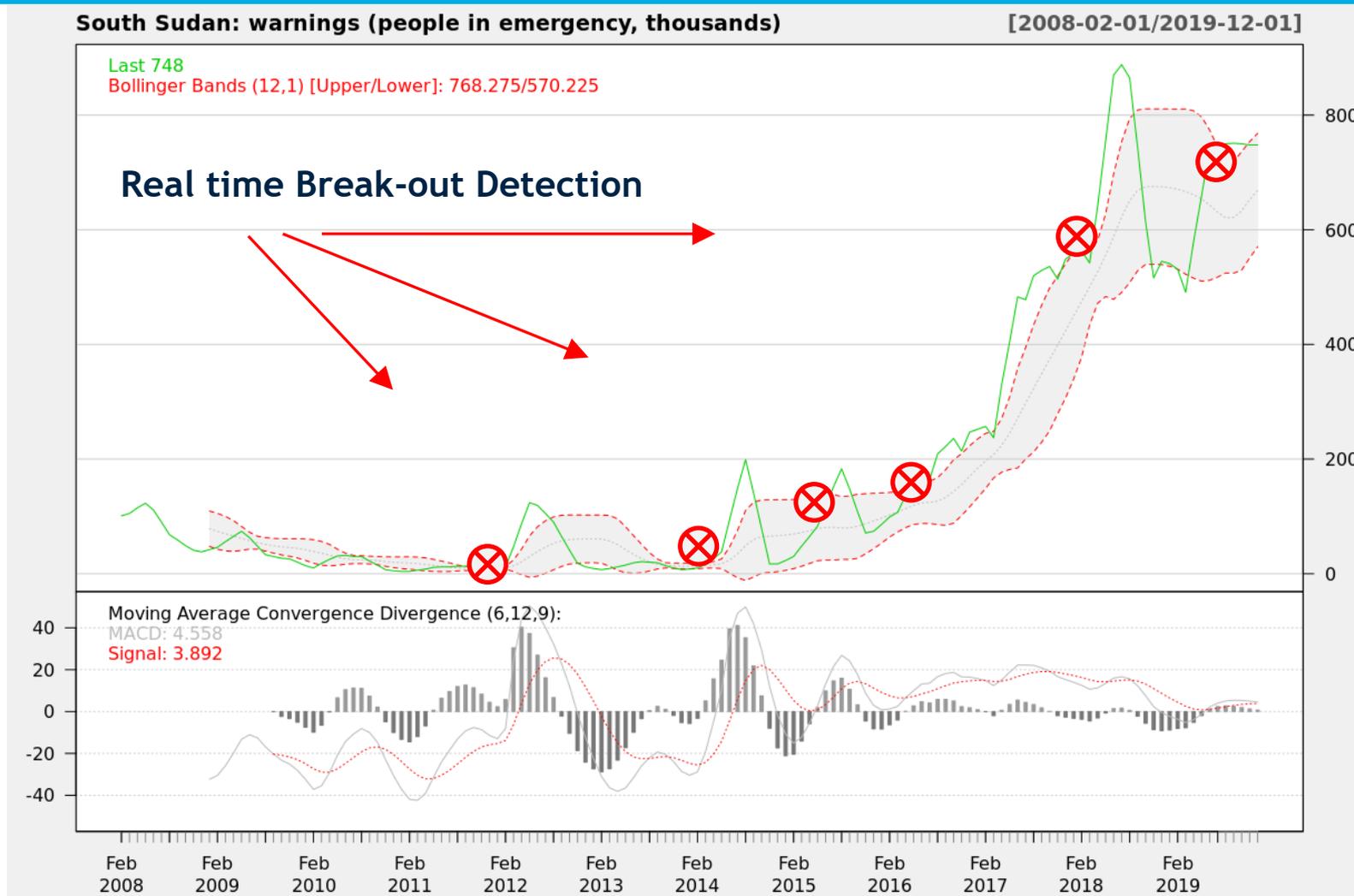Bo Pieter Johannes Andree
12 October 2023

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Overview

- **Advanced empirical analytics for FNS:**
  - **Experimental modeling**
    - *5 country pilot, 2017-2018*
  - **Formalization of proof of concept**
    - *21 country forecasting model, 2019-2020*
    - *15-country simulation model, 2019-2020*
  - **Assessing global needs**
    - *141 country model, 2020-2022*
    - *192 country model, 2022-2023*
  - **Monitoring primary data**
    - *1300+ market-level inflation model, 2021-2023*

- ***From Experiment to Deployment***
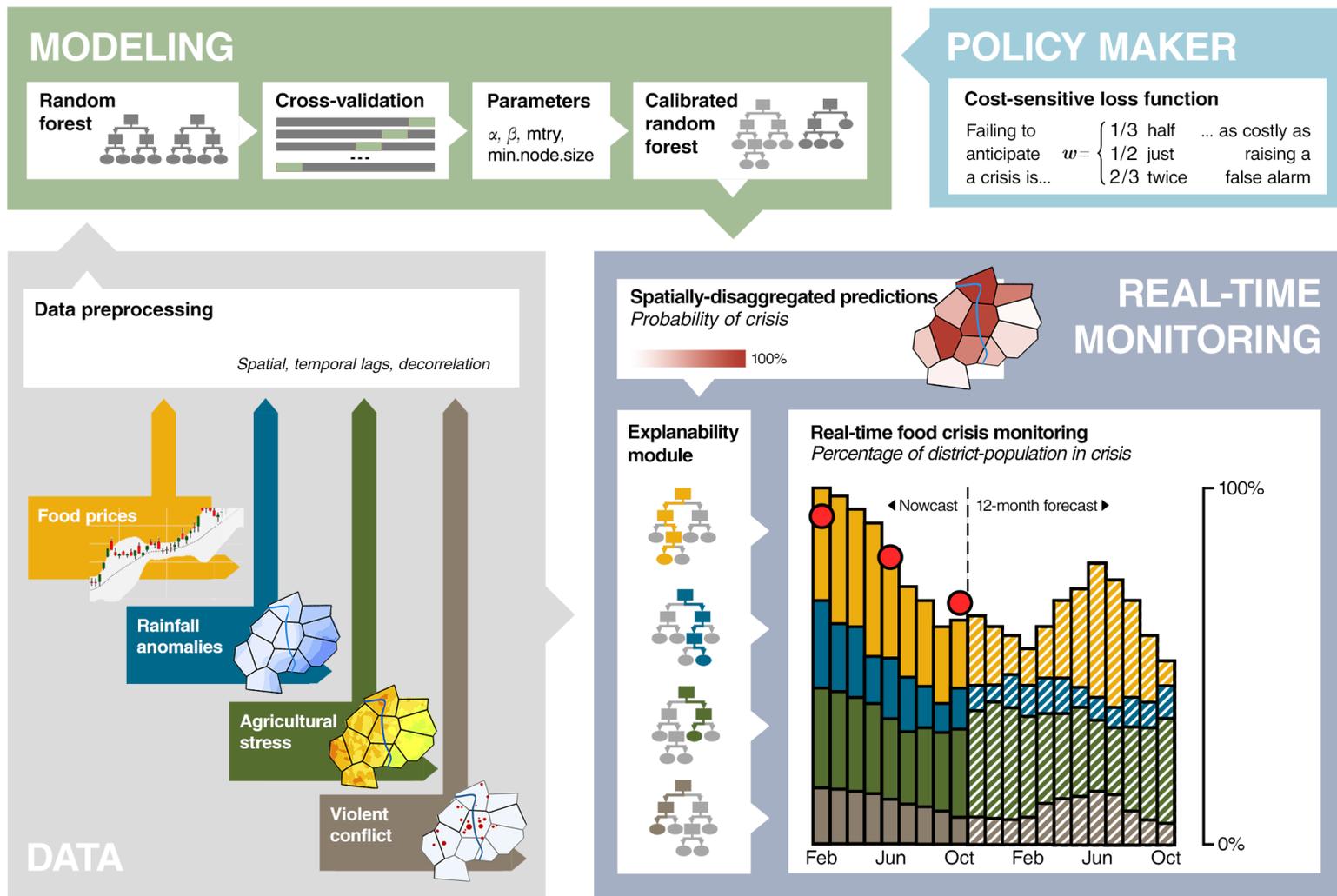
- ***Dissemination through GAFS***

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Experimental modeling – *5 country pilot, 2017-2018*

South Sudan: warnings (people in emergency, thousands) [2008-02-01/2019-12-01]

Last 748
Bollinger Bands (12,1) [Upper/Lower]: 768.275/570.225

Real time Break-out Detection

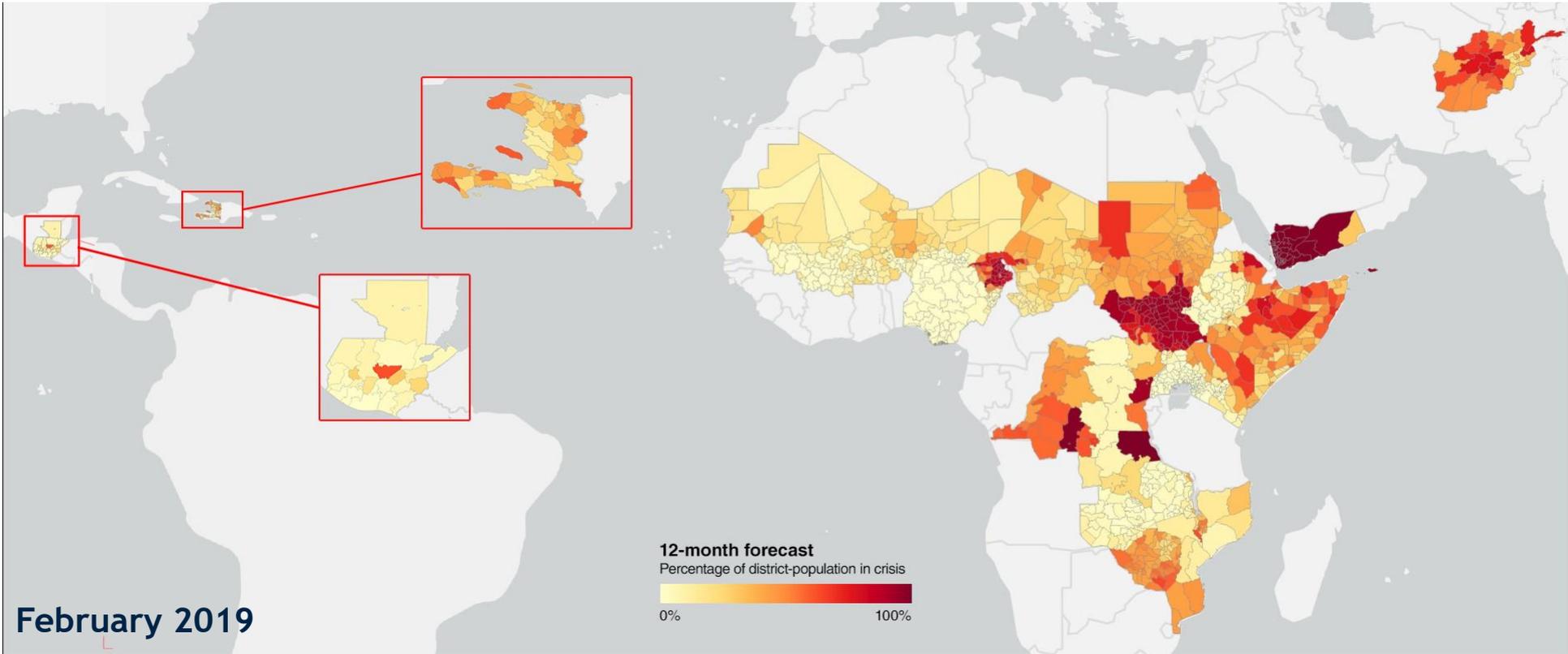Moving Average Convergence Divergence (6,12,9):
MACD: 4.558
Signal: 3.892

5-country pilot model (December, 2018) with IPC and FAM partners:
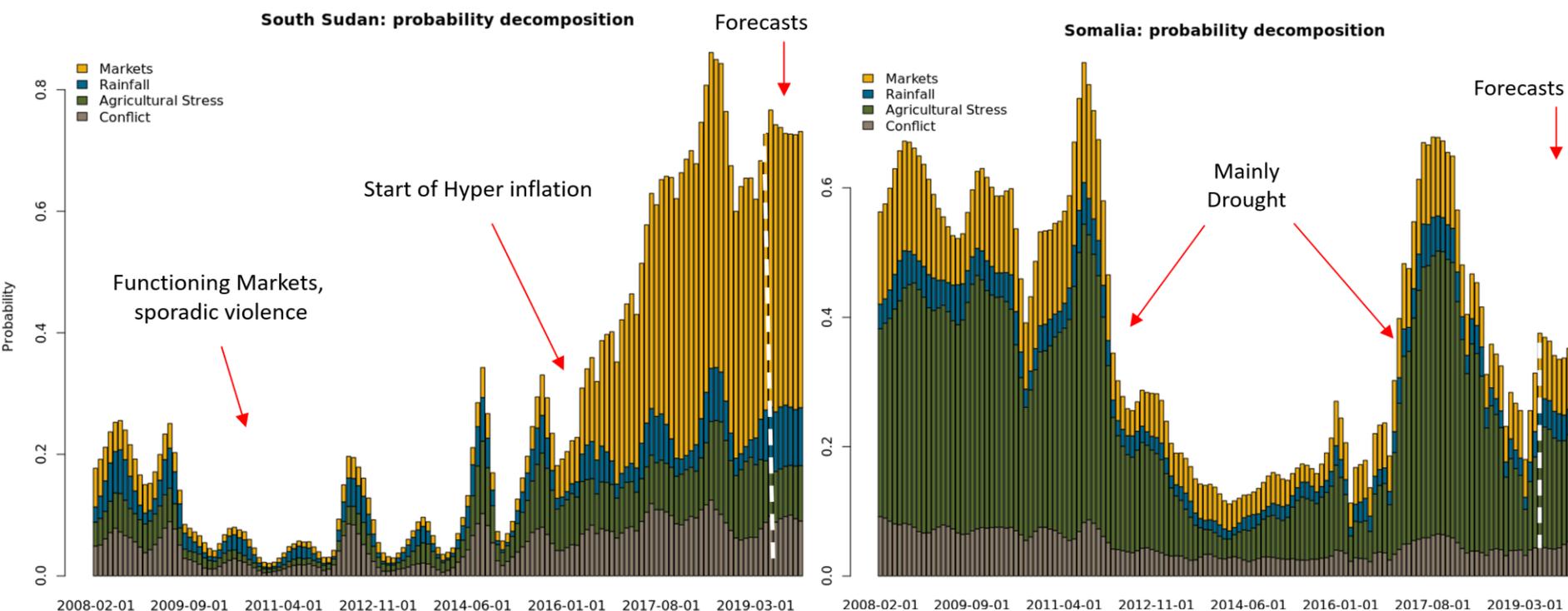https://pubdocs.worldbank.org/en/240281630090216271/pdf/Data-and-analytics-ARTEMIS.pdf

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Formalization of proof of concept – *21 country forecasting model, 2019-2020*
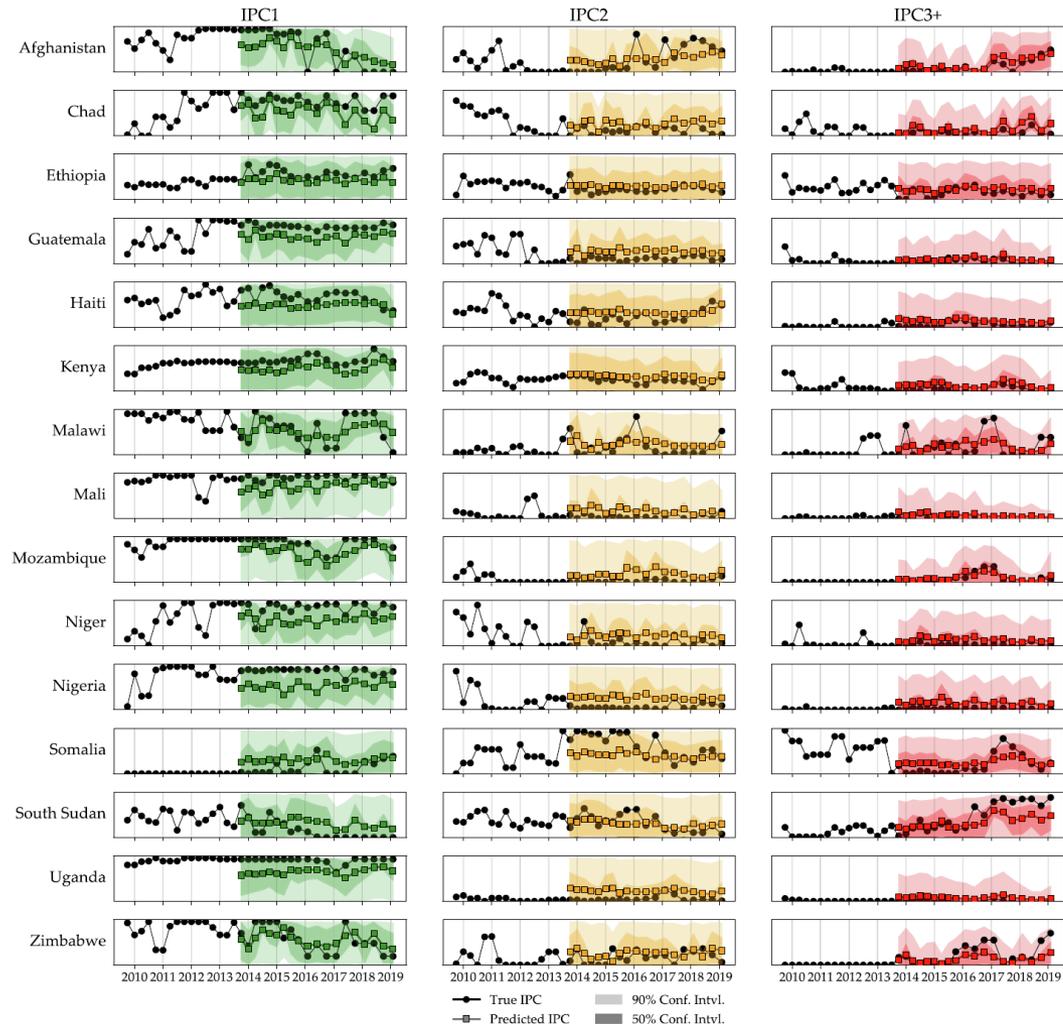
Andree, B.P.J., Chamorro, A., Kraay, A., Spencer, P., Wang, D. (2020). *Predicting Food Crises.* Policy Research Working Paper; No. 9412. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/34510

Formalization of proof of concept – *21 country forecasting model, 2019-2020*

12-month forecast
Percentage of district-population in crisis

0%   100%

February 2019

Andree, B.P.J., Chamorro, A., Kraay, A., Spencer, P., Wang, D. (2020). *Predicting Food Crises.* Policy Research Working Paper; No. 9412. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/34510

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Formalization of proof of concept – *21 country forecasting model, 2019-2020*

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Formalization of proof of concept – *15-country simulation model, 2019-2020*

Wang, D., Andree, B.P.J., Chamorro, A.F., Spencer, G.S. (2020). *Stochastic Modeling of Food Insecurity*. Policy Research Working Paper; No. 9413. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/34511
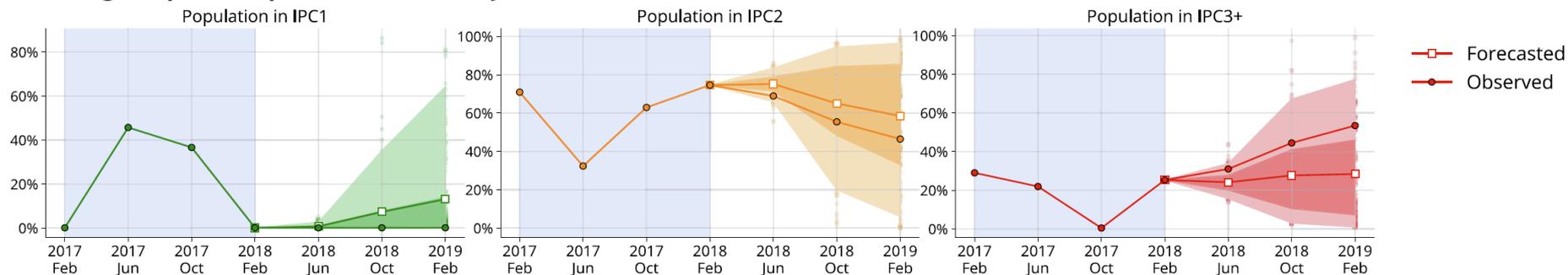
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Formalization of proof of concept – *15-country simulation model, 2019-2020*

Afghanistan

Without expert-opinion
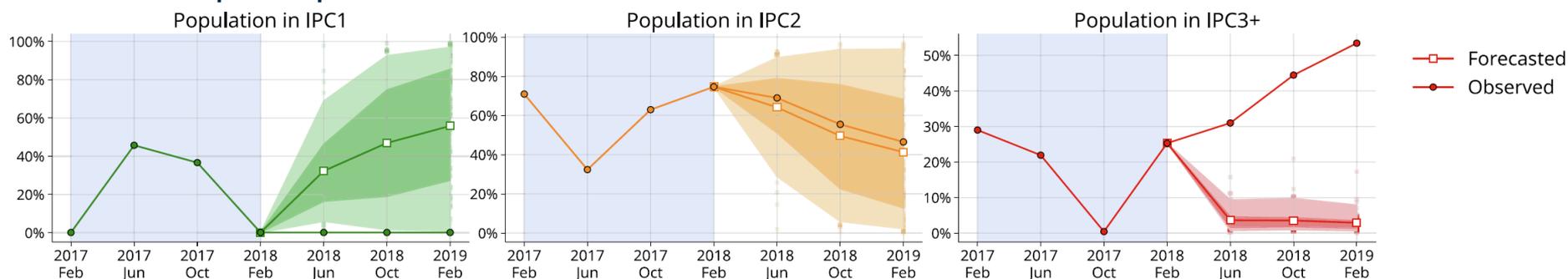
## Using expert-opinion in a Bayesian framework
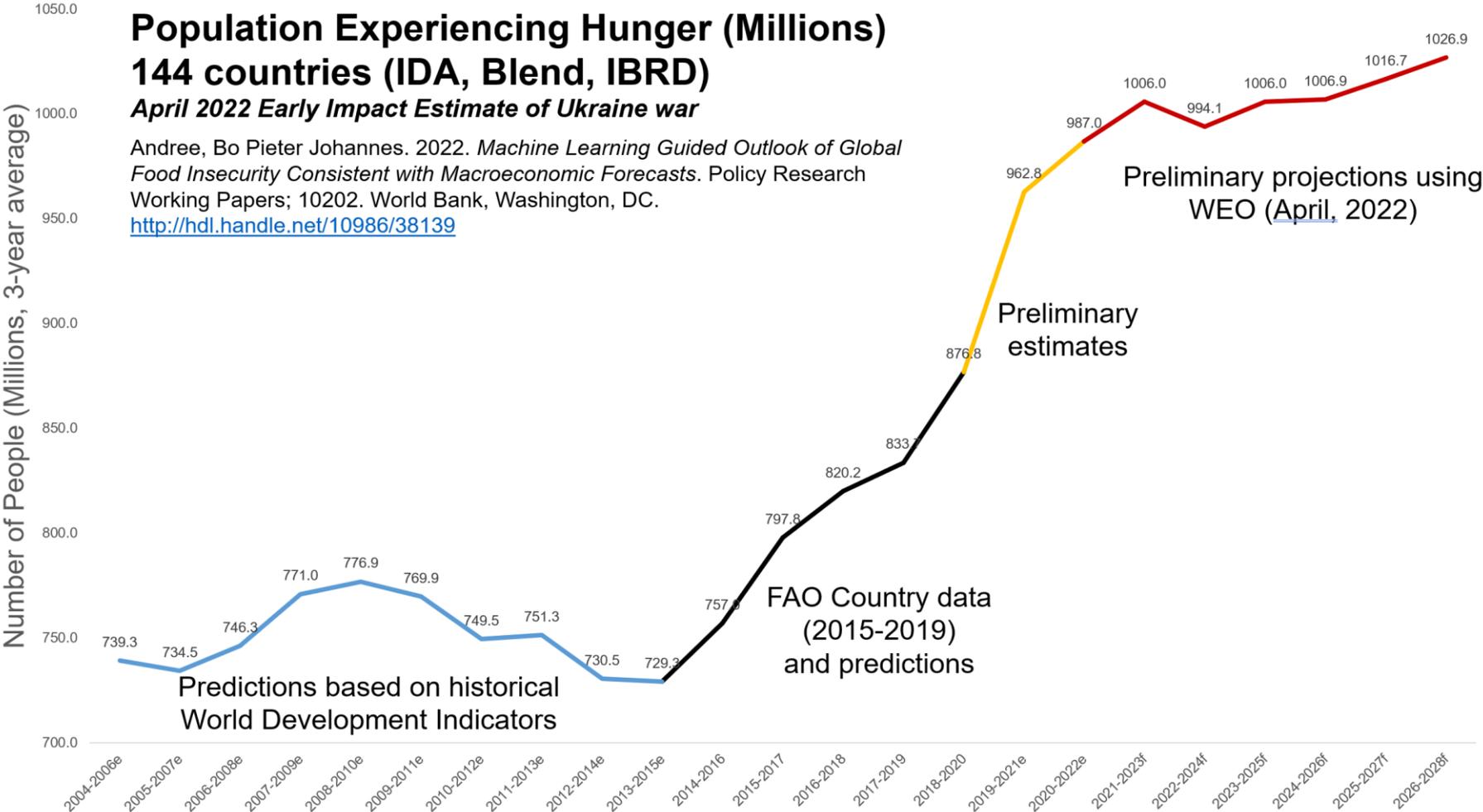
Population Experiencing Hunger (Millions) 144 countries (IDA, Blend, IBRD)
April 2022 Early Impact Estimate of Ukraine war

Andree, Bo Pieter Johannes. 2022. *Machine Learning Guided Outlook of Global Food Insecurity Consistent with Macroeconomic Forecasts*. Policy Research Working Papers; 10202. World Bank, Washington, DC. http://hdl.handle.net/10986/38139

Andree, B.P.J. (2022). *Machine Learning Guided Outlook of Global Food Insecurity Consistent with Macroeconomic Forecasts*. Policy Research Working Papers; 10202. World Bank, Washington, DC. http://hdl.handle.net/10986/38139

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Assessing global needs – *192 country model, 2022-2023*

August 2023 projection, based on IMF World Economic Outlook of April 2023, and development indicators and food insecurity data as of August 2023.

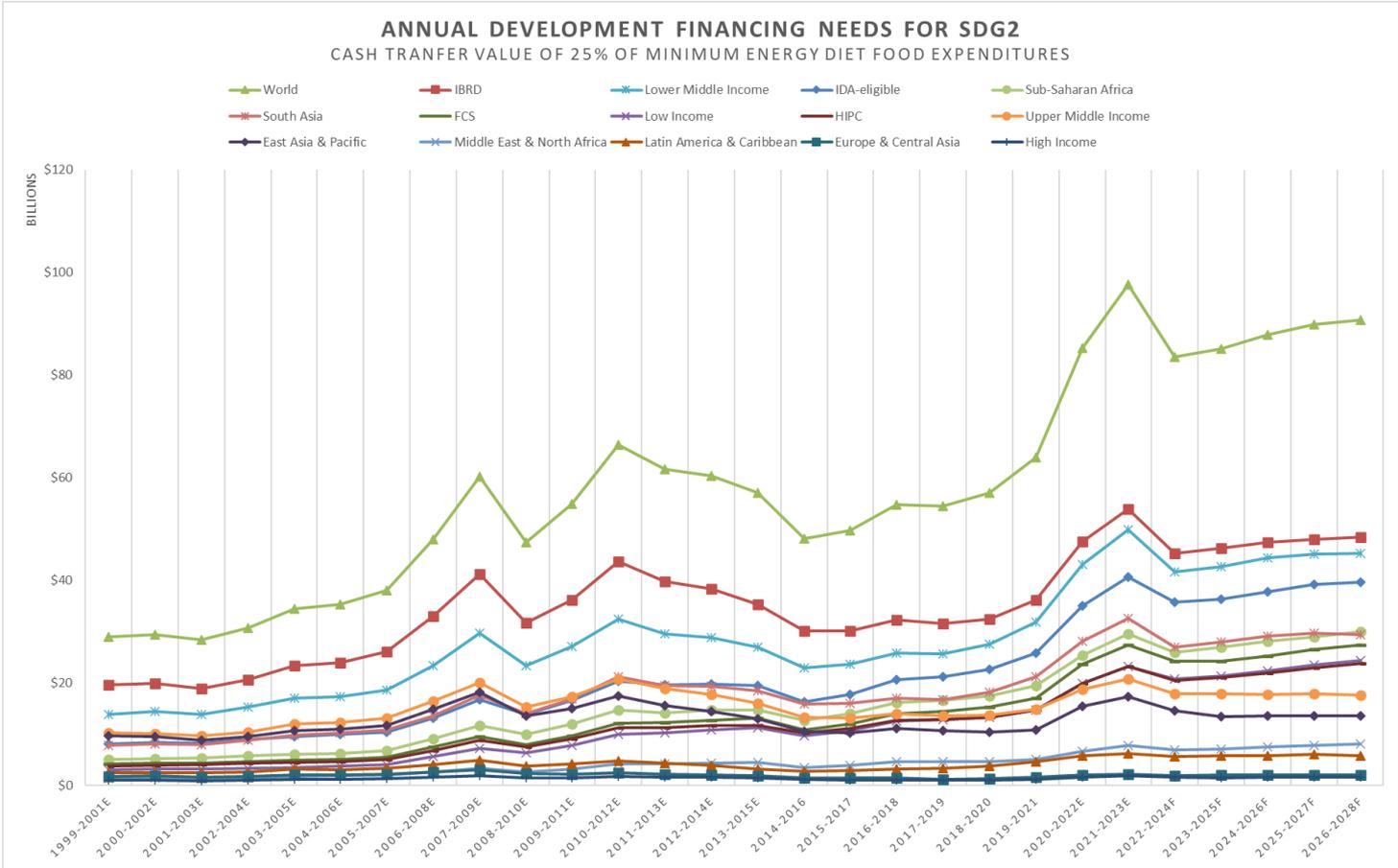**Projected State of Severe Food Insecurity in the World in 2030**

Prevalence of Severe Food Insecurity (Rate)

0   20   40+
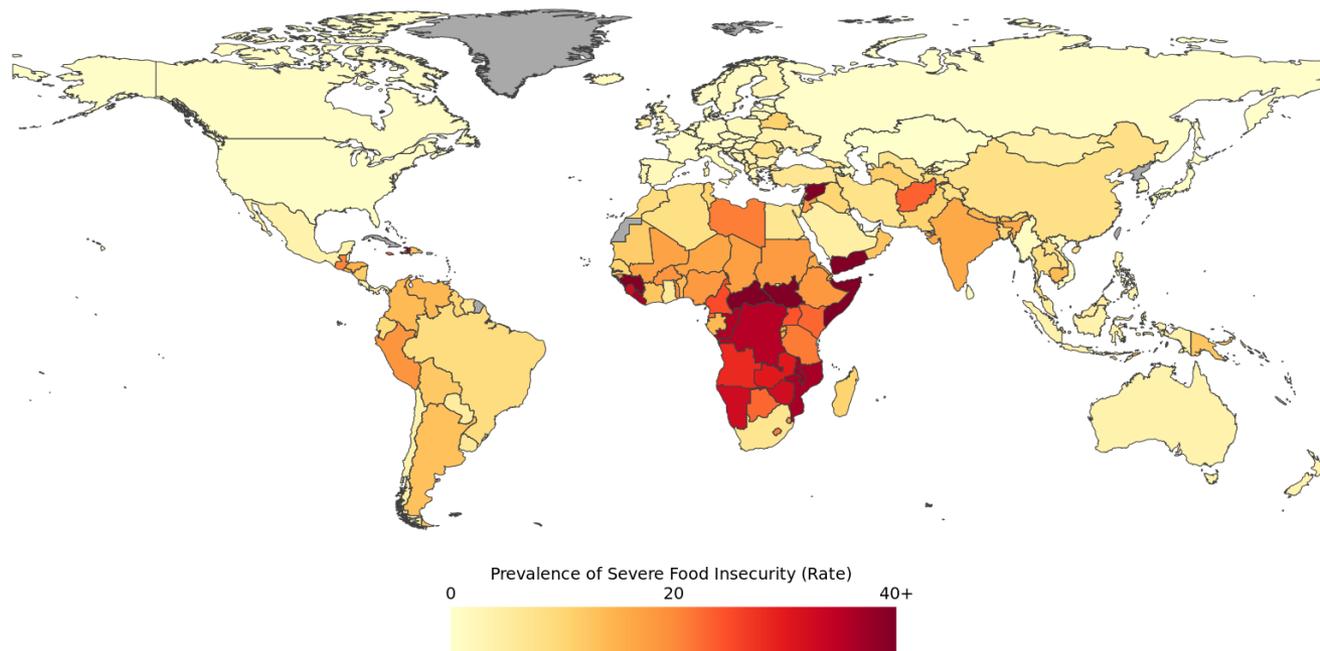
Original methods by: Andree, B.P.J. (2022). Machine Learning Guided Outlook of Global Food Insecurity Consistent with Macroeconomic Forecasts. Policy Research Working Papers; 10202. World Bank, Washington, DC.
This version: Update based on World Economic Outlook, April 2023 and SOFI23 (July, 2023).

Gatti, R., Lederman, D., Islam, A.M., Bennett, F.R., Andree, B.P.J., Assem, H., Lotfi, R., Mousa, M.E. (2023). *Altered Destinies: The Long-Term Effects of Rising Prices and Food Insecurity in the Middle East and North Africa*. MENA Economic Update; April 2023. Washington, DC : World Bank. http://hdl.handle.net/10986/39559

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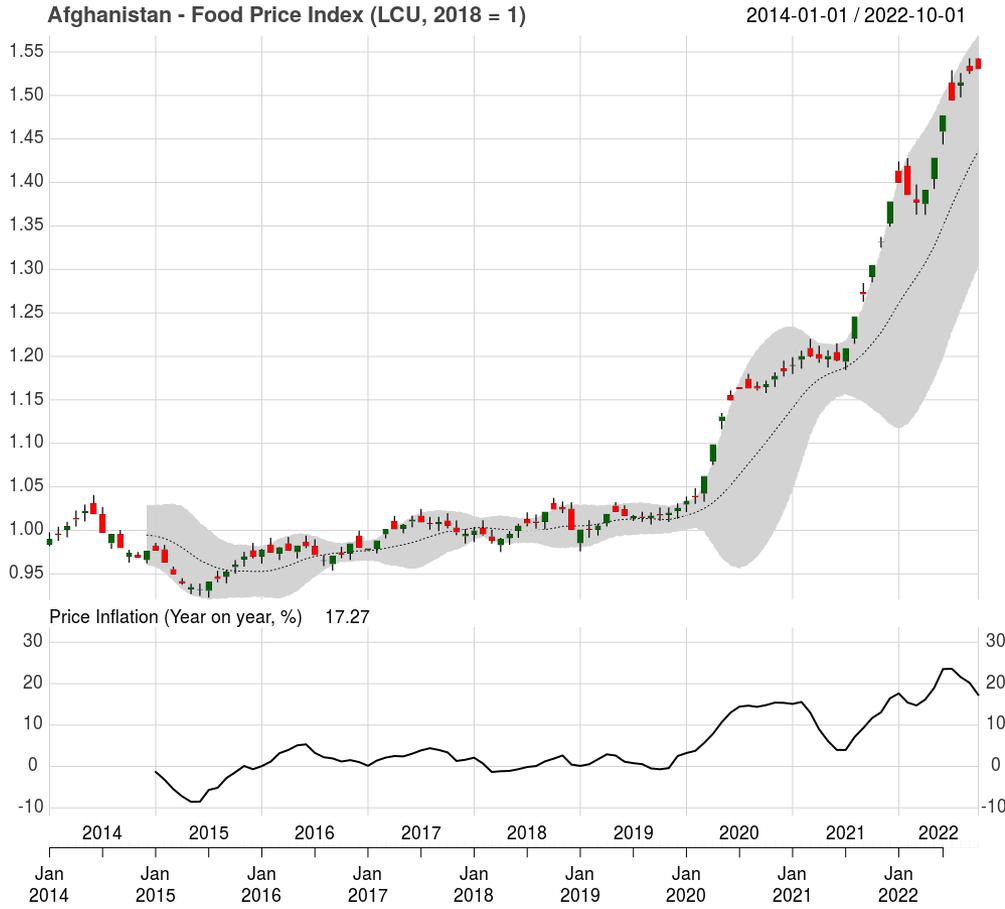# Assessing global needs – *192 country model, 2022-2023*

August 2023 projection, based on IMF World Economic Outlook of April 2023, and development indicators and food insecurity data as of August 2023.

ANNUAL DEVELOPMENT FINANCING NEEDS FOR SDG2
CASH TRANFER VALUE OF 25% OF MINIMUM ENERGY DIET FOOD EXPENDITURES

Legend: World, IBRD, Lower Middle Income, IDA-eligible, Sub-Saharan Africa, South Asia, FCS, Low Income, HIPC, Upper Middle Income, East Asia & Pacific, Middle East & North Africa, Latin America & Caribbean, Europe & Central Asia, High Income

Gatti, R., Lederman, D., Islam, A.M., Bennett, F.R., Andree, B.P.J., Assem, H., Lotfi, R., Mousa, M.E. (2023). *Altered Destinies: The Long-Term Effects of Rising Prices and Food Insecurity in the Middle East and North Africa*. MENA Economic Update; April 2023. Washington, DC : World Bank. http://hdl.handle.net/10986/39559

Monitoring primary data – *1300+ market-level inflation model, 2021-2023*

Afghanistan - Food Price Index (LCU, 2018 = 1)   2014-01-01 / 2022-10-01

Price Inflation (Year on year, %)   17.27

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Monitoring primary data – *1300+ market-level inflation model, 2021-2023*

Real-time Food Prices (continuously updated):
https://microdata.worldbank.org/index.php/catalog/4509

Andrée, B.P.J., Pape, U.J. (2023). *Machine Learning Imputation of High Frequency Price Surveys in Papua New Guinea.* Policy Research Working Papers; 10559. World Bank, Washington, DC. http://hdl.handle.net/10986/40410

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From experiment to deployment

Dissemination through Global Food and Nutrition Security Dashboard

Modeling, findings, and resources will be disseminated through the Global Food and Nutrition Security Dashboard supported by the Global Alliance for Food Security (GAFS)

Dashboard brings together the latest global and country-level data on food crisis severity, country preparedness planning, global food security financing and innovative research to strengthen crisis response and resilience

Thank You!

The IPC Global Partners

The IPC Funding Partners

Resources

Global Alliance for Food Security: a Global, Agile Convening Forum

GAFS Establishment

World Bank and German G7 Presidency launched GAFS in May 2022 to **catalyze an agile and coordinated response to the global FNS crisis**

GAFS Focus Areas

Advice
Discover food crisis severity through data and monitor key ：ators in interactive maps.

Action
Action tracks and shares information on global food security financing.

Advance
Advance presents forward looking research and analysis on food security and resilience.

GAFS Value Additions

GAFS is a temporary forum that brings together **60+ partners**, including governments, humanitarian and development partners for **information exchange and response coordination at global and country level**

GAFS mobilized widespread Partnership among Humanitarian-Development-Peace actors

GAFS Global FNS Dashboard addresses information challenges

Key priority identified by GAFS Steering Group in July 2022 was need for a **one-stop-shop platform** with timely, quality food & nutrition security (FNS) information for decision-makers

WB led development of Dashboard launched at COP27 in November 2022

High-Level Launch of the Global Food & Nutrition Security Dashboard

Svenja Schulze
Federal Minister for Economic Cooperation and Development, Germany

Mari Pangestu
Managing Director of Development Policy and Partnerships, World Bank

Moderator:
Juergen Voegele
Vice President for Sustainable Development, World Bank

(**Dashboard** **video**, launch **blog** and press release)

http://www.gafs.info

GAFS
Global Alliance for Food Security

The Global Food and Nutrition Security Dashboard

brings together the latest info on

To find out more visit **www.gafs.info**   THE WORLD BANK

GAFS
Global Alliance for Food Security

FOODSYSTEMS 2030

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Dashboard displays inter-relatedness of food crisis monitoring, financial response and research to strengthen crisis response

Provides a comprehensive understanding of food and nutrition crises through centralization and visualization of key data and information streams from 40+ GAFS partners

Supports decision-making at country, regional and global-level for donors, governments and FNS partners working to respond to and prepare for emerging crises

Facilitates coordination of humanitarian and development policy and financial responses to crises and resilience-building efforts

GAFS
Global Alliance for Food Security

FOODSYSTEMS 2030

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The Global Alliance on Food Security (GAFS) is also supporting the rollout of Food Security Crisis Preparedness Plans (FSCPPs)
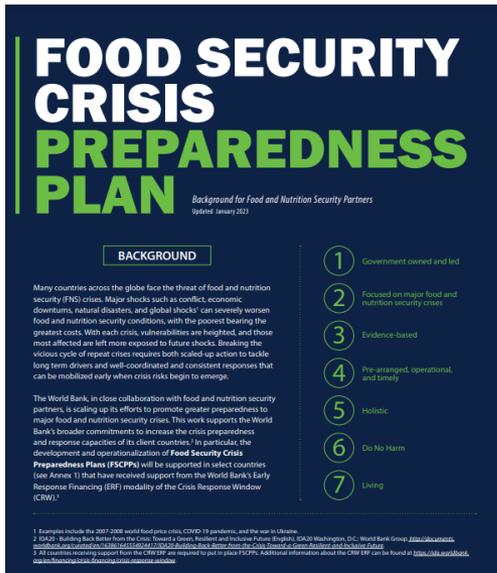
Recent Statements
- Featured in Joint Statement by the Heads of FAO, IMF, WBG, WFP, WTO (Feb 8, 2023)
- Global Network Against Food Crises (GNAFC) (May 3, 2023)
- Hiroshima Action Statement for Resilient Global Food Security (May 20, 2023)

Recent Briefs, Blogs, and Other Media
- Countries Catalyze New Preparedness Plans to More Effectively Respond to Future Food and Nutrition Security Crises (January 2023)
- FSCPP Brochure (January 2023)
- Responding to the realities of a new normal: Deepening and more frequent food crises require a systems rethink (May 23, 2023)
- Table for 10 Billion: Preparing Plans to Mitigate Food Crises (August 21, 2023)

FNS model uses and resources

Andree, B.P.J., Chamorro, A., Kraay, A., Spencer, P., Wang, D. (2020). *Predicting Food Crises.* Policy Research Working Paper; No. 9412. World Bank, Washington, DC.
https://openknowledge.worldbank.org/handle/10986/34510

Resources:
- *Code and Data Set to reproduce key results:* https://microdata.worldbank.org/index.php/catalog/3811
- *Slides presented by Aart Kraay, Deputy Chief Economist of the World Bank, at the AFR/MENA Chief Economists Event on The Economics of Food Insecurity and Looming Famines:* https://thedocs.worldbank.org/en/doc/fa327fbae77fa0823d22b7522b83f822-0280032021/original/Aart-Kraay-Slides.pptx
- *Blog:* Modeling food crises: Looking at a complex problem through two lenses. Dieter Wang, Aart Kraay, Bo Pieter Johannes Andree. December, 2020. https://blogs.worldbank.org/developmenttalk/modeling-food-crises-looking-complex-problem-through-two-lenses
- *Blog:* Can we monitor climate and food crisis risks in real time? Brendan Rice, Rob Vos, Soonho Kim, Grazia Pacillo, Bo Pieter Johannes Andree, Michael Humber, Betina Dimaranan, Yanyan Liu, Peter Läderach, Boram Min, and John Keniston, January 2022. https://www.foodsecurityportal.org/node/1870

Use in IDA:
- *Used to assess IDA Emergency Response Financing demand:* IDA. 2021. Mid Term Review of the Crisis Response Window Early Response Financing. https://documents1.worldbank.org/curated/en/252271636587686210/pdf/IDA19-Mid-Term-Review-of-the-Crisis-Response-Window-Early-Response-Financing.pdf
- *Used for preliminary assessment of the emerging food crisis following COVID-19:* IDA. 2020. Responding to the Emerging Food Security Crisis. https://documents1.worldbank.org/curated/en/775981606955884100/pdf/Responding-to-the-Emerging-Food-Security-Crisis.pdf
- *Used to developed the Triggering Methodology Based on Forecasts for IDA Emergency Response Financing.* IDA. 2019. Additional Information Following up on the Addis Ababa Discussions on Regional, Crisis Response and Private Sector Windows. https://documents1.worldbank.org/curated/en/235601571173809758/pdf/Additional-Information-Following-up-on-the-Addis-Ababa-Discussions-on-Regional-Crisis-Response-and-Private-Sector-Windows.pdf
- *Used as a proof-of-concept for Leveraging Data & Analytics to identify the likelihood of food security conditions evolving into crises.* IDA. 2019. Review of the IDA Crisis Toolkit. https://documents1.worldbank.org/curated/en/275821564074709174/pdf/Review-of-the-IDA-Crisis-Toolkit-Background-Note.pdf

Other use:
- *Used to assess the drivers of food insecurity in the South Sudan country economic memorandum:* World Bank. 2022. Directions for Reform: A Country Economic Memorandum for Recovery and Resilience in South Sudan. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/37532
- *Used to assess the local food insecurity drivers in the country economic update.* World Bank. 2021. South Sudan Economic Update, June 2021 : Pathways to Sustainable Food Security. World Bank, Washington, DC. World Bank. https://openknowledge.worldbank.org/handle/10986/35788
- *Used of consolidated lessons to develop the approach to crisis prevention and preparedness as part of the pillar of engagement in FCV.* World Bank. 2019. World Bank Group Strategy for Fragility, Conflict, and Violence (FCV) 2020-2025. https://www.worldbank.org/en/topic/fragilityconflictviolence/publication/world-bank-group-strategy-for-fragility-conflict-and-violence-2020-2025
- *In supporting IPC GSU and Steering Committee establishing the Advanced Technology and Artificial Intelligence initiative.* IPC. 2019. IPC ATARI Report #1 Key opportunities for Advanced Technologies and Artificial Intelligence. https://www.ipcinfo.org/fileadmin/user_upload/ipcinfo/docs/IPC-ATARI-Report-_1.pdf
- *Used to show proof-of-concept to forecast-based triggering of UN's Central Emergency Response Fund (CERF).* Mark Lowcock. 2019. Call for Predictive Analytics. https://www.youtube.com/watch?v=faJT7Nzg60I ; UN-OCHA. 2019. Workshop Report on Predictive Analytics. https://centre.humdata.org/wp-content/uploads/2019/05/Workshop-Report-Predictive-Analytics-April-2019.pdf ; UN-OCHA. 2019. Press release on anticipatory finance allocation in prevention of famine in Somalia https://cerf.un.org/news/story/cerf-allocates-45-million-stave-famine-risks-horn-africa
- *Used of consolidated lessons to develop the approach to Risk and Crisis Monitoring, Analysis, and Knowledge, as integrated into the Global Crisis Risk Platform.* World Bank. 2018. Global Crisis Risk Platform. https://documents1.worldbank.org/curated/en/762621532535411008/pdf/128852-BR-SecM2018-0217-PUBLIC-new.pdf
- *As part of status update on the Bank's work on prevention and response.* UN Secretary General António Guterres and World Bank President Jim Yong Kim announcement at the event on Partnering to Address Acute Food Insecurity, UNGA 2018. https://media.un.org/en/asset/k1v/k1vj6eq7e0
- *As motivation for the announcement of the Bank's new focus on prevention and response.* UN Secretary General António Guterres and World Bank President Jim Yong Kim announcement at the High-Level Event on Famine Prevention and Response, UNGA 2017. https://media.un.org/en/asset/k1k/k1kdukvuwe

FNS model uses and resources

Wang, D., Andree, B.P.J., Chamorro, A.F., Spencer, G.S. (2020). *Stochastic Modeling of Food Insecurity*. **Policy Research Working Paper; No. 9413. World Bank, Washington, DC.**
https://openknowledge.worldbank.org/handle/10986/34511
Wang, D., Andree, B.P.J., Chamorro, A.F., Spencer, G.S. (2022). *Transitions into and out of food insecurity: A probabilistic approach with panel data evidence from 15 countries.* **World Development, Volume 159, 2022, https://doi.org/10.1016/j.worlddev.2022.106035**

- *Used to identify threshold risks in non-crisis LICs.* World Bank. 2022. Global Economic Prospects, June 2022: Stagflation Risk Rises Amid Sharp Slowdown in Growth. https://www.worldbank.org/en/news/press-release/2022/06/07/stagflation-risk-rises-amid-sharp-slowdown-in-growth-energy-markets
- *Used to draw lessons from Bank's response to food insecurity.* World Bank Independent Evaluation Group. 2021. Food and Nutrition under the COVID-19 Crisis: Lessons for Protecting the Vulnerable and Facilitating Recovery. https://ieg.worldbankgroup.org/sites/default/files/Data/Topic/COVID19Lessons_foodandnutrition.pdf
- *Used for preliminary assessment of the emerging food crisis following COVID-19.* IDA. 2020. Responding to the Emerging Food Security Crisis. https://documents1.worldbank.org/curated/en/775981606955884100/pdf/Responding-to-the-Emerging-Food-Security-Crisis.pdf
- *Used to developed the Triggering Methodology Based on Forecasts for IDA Emergency Response Financing.* IDA. 2019. Additional Information Following up on the Addis Ababa Discussions on Regional, Crisis Response and Private Sector Windows. https://documents1.worldbank.org/curated/en/235601571173809758/pdf/Additional-Information-Following-up-on-the-Addis-Ababa-Discussions-on-Regional-Crisis-Response-and-Private-Sector-Windows.pdf

Andree, B.P.J. (2022). *Machine Learning Guided Outlook of Global Food Insecurity Consistent with Macroeconomic Forecasts*. **Policy Research Working Papers; 10202. World Bank, Washington, DC. http://hdl.handle.net/10986/38139**

- *Used to motivate the scale of the World Bank's 30 Billion$ Global Food Crisis Response.* https://www.worldbank.org/en/news/press-release/2022/05/18/world-bank-announces-planned-actions-for-global-food-crisis-response
- *Used for preliminary assessment of the emerging food crisis following COVID-19:* IDA. 2020. Responding to the Emerging Food Security Crisis. https://documents1.worldbank.org/curated/en/775981606955884100/pdf/Responding-to-the-Emerging-Food-Security-Crisis.pdf
- *Used to assess IDA Emergency Response Financing demand through 2021-2026.* IDA. 2021. Mid-Term Review of the Crisis Response Window Early Response Financing. https://documents1.worldbank.org/curated/en/252271636587686210/pdf/IDA19-Mid-Term-Review-of-the-Crisis-Response-Window-Early-Response-Financing.pdf
- *Used to assess long-term food insecurity impacts of inflation in the MENA region:* Gatti, R., Lederman, D., Islam, A.M., Bennett, F.R., Andree, B.P.J., Assem, H., Lotfi, R., Mousa, M.E. (2023). *Altered Destinies: The Long-Term Effects of Rising Prices and Food Insecurity in the Middle East and North Africa*. MENA Economic Update; April 2023. Washington, DC. World Bank. http://hdl.handle.net/10986/39559
- *G-24 financing perspectives for FNS*: https://www.g24.org/wp-content/uploads/2023/03/Martien-Van-Nieuwkoop-Responding-to-Rising-Food-Insecurity.-A-Financing-Perspective.pdf

Andree, B.P.J. (2021). *Estimating Food Price Inflation from Partial Surveys.* **Policy Research Working Paper; No. 9886. World Bank, Washington, DC.**
https://openknowledge.worldbank.org/handle/10986/36778
Andrée, B.P.J., Pape, U.J. (2023). *Machine Learning Imputation of High Frequency Price Surveys in Papua New Guinea.* **Policy Research Working Papers; 10559. World Bank, Washington, DC.**
http://hdl.handle.net/10986/40410

- *Deployed to produce and disseminate real-time estimates of food price inflation in data-poor regions via the World Bank's Microdata Library:* https://microdata.worldbank.org/index.php/catalog/4509
- *Blog:* https://blogs.worldbank.org/opendata/new-machine-learning-method-provides-real-time-estimates-local-food-prices-crisis-affected
- *Deployed as part of the Pacific Observatory to evaluate the ability to produce real-time data with mobile-phone surveys:* https://www.worldbank.org/en/country/pacificislands/brief/the-pacific-observatory
- *Slides presented to UNIDO Second technical workshop on nowcasting in international organizations, May 2022:* https://stat.unido.org/pdf/NowcastingWorkshop-Day2-WorldBank.pdf
- *Slides with pilot results presented to Digital Technology for Development Fund:* https://microdata.worldbank.org/index.php/catalog/4509/related-materials
- *Used to assess the food insecurity impacts of inflation in the South Sudan country economic memorandum:* World Bank. 2022. Directions for Reform : A Country Economic Memorandum for Recovery and Resilience in South Sudan. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/37532
- *Used to assess the local food insecurity impacts of inflation in the country economic update.* World Bank. 2021. South Sudan Economic Update, June 2021 : Pathways to Sustainable Food Security. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/35788
- *Used by the compound risk monitor of the Global Crisis Response Platform (GCRP):* https://compoundrisk.github.io/index.html