

Stocktaking Overview of the G20 Global Agricultural Monitoring (GEOGLAM) Initiative since the Inception of the 2011 Action Plan on Food Price Volatility

Background

The Group on Earth Observations Global Agricultural Monitoring Initiative (GEOGLAM) was initially launched by the Group of Twenty (G20) Agriculture Ministers in Paris, June 2011 during the French G20 Presidency. The GEOGLAM Initiative forms part of the G20 Action Plan on Food Price Volatility. GEOGLAM is a Group on Earth Observations (GEO) Flagship Initiative and is managed by the GEOGLAM Secretariat at GEO Secretariat in Geneva, hosted by the United Nations World Meteorological Organization.

The goal of GEOGLAM is to increase market transparency and improve food security by producing and disseminating relevant, timely, and actionable information on agricultural conditions and outlooks on production at national, regional, and global scales. It achieves this by strengthening the international community's capacity to utilize coordinated, comprehensive, and sustained Earth observations.

The approach is to build on existing systems where possible, and where systems do not exist, to develop national capacity to utilize Earth observations. In doing so GEOGLAM strengthens national systems within the main producer countries and in countries-at-risk of food insecurity. Simply put, EO can help to provide better, more objective and synoptic information on crop production, and better information allows for better decision making at all levels, from the farmer to commodity markets, all the way up to national and global policy and programs.

GEOGLAM is implemented through a small Secretariat coordinating a system of volunteer national and international agricultural monitoring systems, and an Executive Committee, consisting of: Co-Chairs; the lead members of the Thematic Coordination Teams; GEOGLAM Regional Network Coordinators; major contributors; and the Programme Director. An External Advisory Committee provides high-level strategic and policy guidance on future priorities for GEOGLAM, while also assisting the GEOGLAM leadership in securing financial resources.

Most G20 countries have some type of operational monitoring system, some of which include the use of Earth observations. GEOGLAM provides a forum for this community, enabling countries to participate actively, share experiences, and keep abreast of new developments in this field. Through regional and thematic workshops, GEOGLAM provides an opportunity for the community of operational data users, researchers, and data producers to gather together. GEOGLAM encourages participants to share their methods, to understand how the various monitoring systems are working, and by extension make the creation of national estimates transparent. Through this convening power, GEOGLAM also provides a unified voice to advocate for sustained Earth observations from G20 space agencies, and for their use by national governments including agricultural ministries.

The GEOGLAM Advisory Committee, the GEOGLAM Executive Committee, and the Initiative's operational research & development group meet twice annually. Research, technical workshops, and regional meetings are too numerous to list in this document. A preliminary engagement analysis conducted in the last month has identified 138 contributors to GEOGLAM from 62 organizations in 28 countries and 16 inter-governmental agencies, encompassing national departments of agriculture, international organizations, universities, and research institutions among others.

Activities and Outcomes

The GEOGLAM Crop Monitors

In response to the 2011 G20 Action Plan on Food Price Volatility and Agriculture, GEOGLAM and the Agricultural Market Information System (AMIS) established a strong partnership. Responding to a

direct request from AMIS, GEOGLAM's contribution to market information is an international consensus report based on Earth observation data and expert input from a network of over 40 participants around the world, including global assessments by China's CropWatch; United States Department of Agriculture's Crop Explorer; and the European Commission's MARS system. GEOGLAM developed a monthly reporting system for the 4 major AMIS crops (wheat, maize, soybean, and rice) for the AMIS producer countries responsible for over 80% of global production. Since September 2013, 48 monthly GEOGLAM Crop Monitor for AMIS bulletins have been generated for inclusion in the AMIS Market Monitor (<http://www.amis-outlook.org/>). As of 2016, GEOGLAM is a member organization of the AMIS Secretariat.

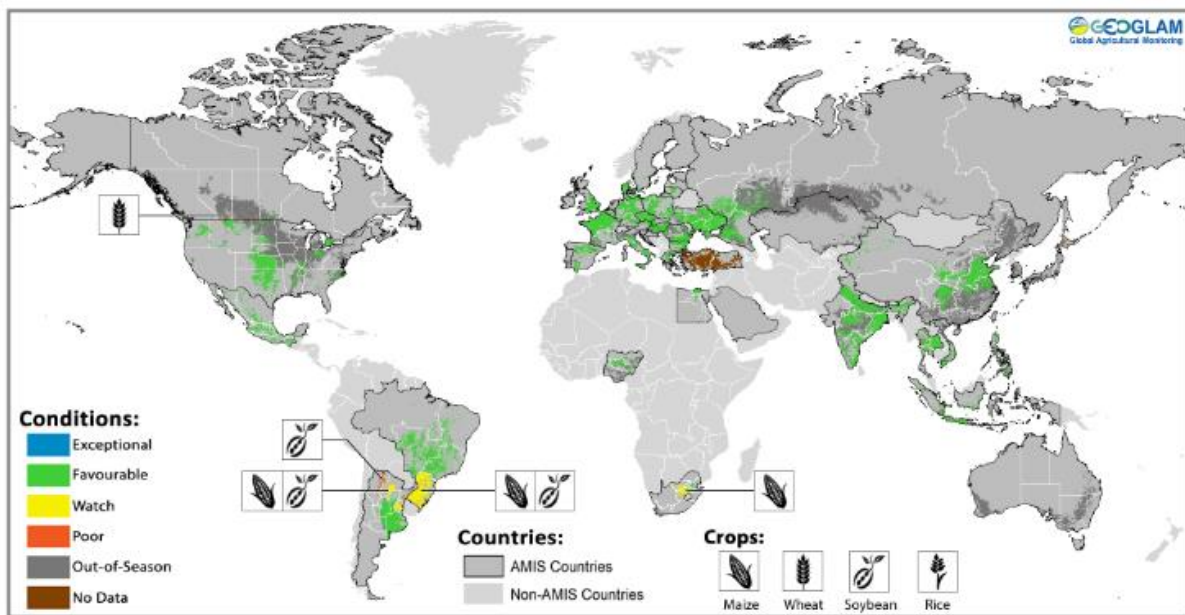


Figure 1 Crop Monitor for AMIS, February 2018

In 2016, building on the success of the Crop Monitor for AMIS, GEOGLAM partnered with many of the major global food security organizations to develop a crop monitor for countries at risk of food insecurity. In contrast to the Crop Monitor for AMIS, the Crop Monitor for Early Warning (CM4EW) focuses on a range of 14 crops that have regional food security implications. As of December 2017, 23 monthly CM4EWs have been published (<https://cropmonitor.org/>).

The early warning focus has now moved to engaging regional and national organizations. As an example both Tanzania and Uganda are operating national Crop Monitors that are supporting national decisions, including mobilization of food and resources in response to emerging emergencies. The Crop Monitor publications are internationally recognized as a reliable source of information on global crop conditions, and are used by a range of ministries and multi-national and governmental organizations to inform agricultural decisions.

The next steps for the Crop Monitor in 2018: AMIS has expressed a need for more quantitative crop metrics through the growing season, including an expansion to yield forecasting, as well as a need to understand the impact of climate change and increasing climate extremes on agricultural production over time. The next steps for collaboration with AMIS are to establish more quantitative indicators of crop production and enhance national capacities to carry out the analyses. GEOGLAM also aims to increase national participation and to help build national and regional instances of the Crop Monitor to strengthen and better inform national food security policy, decision, and action. In 2018, there will be a focus on developing new regional Crop Monitors in Latin America, and in East Africa, as well as national monitors in Vietnam and Kenya. The development of stronger national and regional capabilities results in better information from national to global scales. Together the AMIS and early

warning crop monitors provide a consensus monthly bulletin across 72 countries, covering most of global crop production.

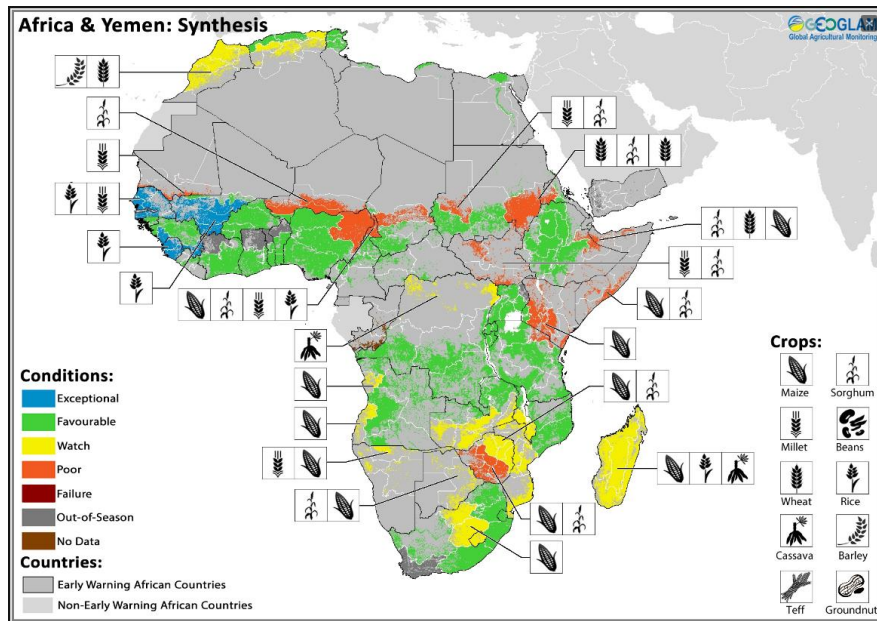


Figure 2 Example of CM4EW for Africa, February 2018

Beyond crop production, livestock production on range and pasturelands are an important component of the global food supply. Currently, there is no comprehensive global effort for monitoring the status and productivity of pastures and rangelands. Under the GEOGLAM banner, a new Rangeland and Pasture Productivity (RAPP) monitor is under development. The RAPP initiative is bringing together space agencies, in-situ networks, and experts to establish a dedicated global system for observing and reporting on the condition of pastures and rangeland.

Research and Development

Any operational system, particularly one based on a quickly evolving technology like Earth observation, must be underpinned by a strong R&D foundation. The operational R&D foundation of GEOGLAM is the Joint Experiments for Crop Assessment and Monitoring (JECAM). Currently the JECAM network is focused on R&D towards the development of operational crop type, area, and condition analysis.

Within projects funded by G20 nations, JECAM conducts method inter-comparison research on a network of more than 30 data-rich test sites around the world. Its goal is to reach a convergence of analytical approaches, developing monitoring and reporting protocols and best practices for a variety of global agricultural systems. Past cross-site experiments have resulted in the development of tools to utilize free and open data from Europe's Sentinel satellite constellations and USGS/NASA Landsat data. More recent cross-site experiments include the use of synthetic aperture radar (SAR) data for crop type mapping and biomass estimation.

Next steps for GEOGLAM Research and Development in 2018: GEOGLAM has generated significant peer-reviewed science already. While this will continue through 6 ongoing experiments, the challenge for 2018 is to strengthen and accelerate the transition from research to operational implementation. This will be supported by converting the published science into a compendium of best practices to serve as technical guidance for operational capacity development activities which will be executed through GEOGLAM's regional networks, and national initiatives. Research will also be accelerated to capitalize on the evolving "big data" opportunities using mobile technologies, crowdsourcing, cloud computation, data cubes, and effectively tapping into the wealth of openly available Earth Observation data.

Earth Observation Data Coordination

Developing a system of systems for global agricultural monitoring requires highly coordinated and sustained access to Earth observation data. Consequently, from the outset GEOGLAM established a strong partnership with public space agencies through the Committee on Earth Observation Satellites (CEOS). CEOS serves as the space arm of GEO, and is composed of over 50 member organizations with close to 300 active space instruments, representing \$10's of billions in space assets. GEOGLAM provides the international public space agencies with a consensus on the observation requirements for agricultural monitoring. The initial requirements, first established in 2012, include spatial, temporal, and spectral requirements for the variety of cropping systems found around the world. They have been guiding the interaction between GEOGLAM and CEOS over the past 5 years.

The next steps for Data Coordination in 2018: Given the increase in data availability since 2012 and the resulting challenges related to data infrastructure and management, a major revisit of the original GEOGLAM requirements will be undertaken in 2018. A holistic review will be conducted looking once again at data acquisition needs, but expanding to include a new focus on data access, development of analysis ready data, and data utilization infrastructure (cloud processing and data cubes).

Regional Networks

Five years into GEOGLAM, experience has demonstrated that the best way to improve crop monitoring capacity from national to global scales is through regional networks. Regions usually share common priorities and opportunities, similar market connections, common cultivars, and agricultural systems. They also confront common challenges like infrastructure, data accessibility, and regional climate variability (e.g. El Niño).

Over recent years a number of regional GEOGLAM initiatives have been initiated, including: Asia-RiCE, led by Japan; AfriGAM led by South Africa; and, GEOGLAM Latinoamérica, led by Argentina. While most GEOGLAM regional initiatives are still in their nascent form, they promise to accelerate the adoption of Earth observation technologies and in turn improve crop monitoring at the national, regional, and by-extension global levels.

The next steps for Regional Networks in 2018: The past months have seen the establishment of the Digital Belt and Road Agriculture (DBAR-Agri) initiative and EuroGEOSS, which stand to further progress GEOGLAM's regional activities. Each regional initiative is at a different level of implementation, with Asia-RiCE (established in 2012) leading the way for national cooperation in regional initiatives. In 2018 DBAR-Agri, GEOGLAM Latinoamérica, and AfriGAM will focus on building in-country support for participation in these networks, while also identifying stakeholders and undertaking a holistic assessment of data, information services, gaps, opportunities, and priorities for agricultural monitoring at national and regional levels.

Emerging Priorities, Opportunities and Challenges Going Forward

Emerging Priorities and Opportunities

As we envisage the next five years of GEOGLAM, it is anticipated that the major policy drivers will include the evolving needs of the market information community. They will also include the needs of the sustainable development community, in particular support for the 2030 United Nations Sustainable Development Goals (UN SDG's). Fortunately, the information developed by GEOGLAM to meet the original intent of the 2011 G20 action plan can already provide fundamental insight into the state and changes in the agricultural landscape at sub-annual and multiannual time scales.

GEOGLAM will undertake a joint activity with AMIS to assess the economic benefit of improved crop forecasts as afforded by Earth observations that will identify priority crops, regions to monitor and will help guide GEOGLAM's crop monitor activities in the coming years.

AMIS and others involved in the monitoring of agricultural markets have clearly articulated the need to establish more quantitative metrics related to crop production, including early-season crop area estimation and within-season yield forecasting. Some GEOGLAM nations are already doing this, and as GEOGLAM looks to the future, it will build on these examples to continually improve the generation of quantitative crop production metrics to support markets and food security to contribute to additional matters of national and global security (e.g. UN SDGs and environmental change).

GEOGLAM will also focus on developing cloud-based analytical systems, providing access to open data and shared agricultural monitoring algorithms to facilitate GEOGLAM partners' ability to carry out their own agricultural analysis at national and regional levels. This improvement will significantly enhance the capacity of major producers and food-insecure countries to develop policy relevant information from Earth observations.

Challenges

As we enter 2018, the outlook for GEOGLAM is very positive. A new Programme Director is in place for the next two years with funding from the German Agriculture Ministry, and the GEOGLAM Crop Monitors have sustained funding for the next five years from the United States. Despite this, however, we have evolving priorities that will require incremental attention and will create a number of challenges and opportunities for delivery. The top challenges that the G20 nations can help to address include:

- GEOGLAM leverages many investments made by G20 nations. Key to coordinating and harnessing these contributions is a small Secretariat. At this time support for the GEOGLAM Secretariat is below critical mass. Incremental support for the Secretariat from G20 nations is required, and a white paper has been produced identifying and prioritizing these needs.
- Big data approaches offer great promise for agricultural monitoring. New information technologies that integrate crowd sourced and multi-thematic data with Earth observations will produce more quantitative multi-temporal assessments. Additional investment is required in the development of knowledge management and analytical infrastructure. GEOGLAM provides an important link between data providers, data analysts, and information users, and investment in optimizing this pipeline would be well-placed.
- Regional networks are key to the evolution of GEOGLAM to meet policy priorities. Enhancing the networking of initiatives will permit nations to share science and operational experiences to accelerate the research to implementation continuum. Initiation of networks has been successful, but incremental investments are required to invigorate and ensure sustained national participation, as well as to facilitate this network of networks.
- Funding is required to ensure inclusion of transitional economies and developing countries (vis-à-vis participation in workshops, IT systems implementation, and training).

In Conclusion

GEOGLAM activities have made significant contributions to the body of agricultural monitoring research, and have effectively capitalized on them to build operational systems that strengthen national capacities that contribute to a near real time system to derive global consensus on crop conditions. Working with AMIS, GEOGLAM has provided science-based consensus information contributing to the goals of the 2011 G20 Action Plan on Food Price Volatility. As GEOGLAM looks forward to 2018, the year of the Argentinian Presidency, we see a new emphasis on strengthening regional coordination. As we look beyond 2018, GEOGLAM will seize upon the opportunity provided by ever increasing access to open EO data and the transformational power of evolving information technologies to deliver information to strengthen markets and global food security. GEOGLAM thanks the G20 nations for their support and we look forward to providing them with ever improving, policy relevant, timely, science-based, consensus information to assist in their decision making.