GEOGLAM
GLOBAL AGRICULTURAL MONITORING

Meeting Report & Next Steps:
GEOGLAM Workshop on Essential Agricultural Variables

Louvain-La-Neuve, Belgium | 23-24 October 2019

Summary:

About this document: Drafted by Alyssa Whitcraft & Sven Gilliams, co-leads of the Essential Agricultural Variable for GEOGLAM Working Group (EAV WG for short) to document outcomes (and actions) as related to meeting objectives, and the way forward.

Participants:

Name	Affiliation		Name	Affiliation
Ian Jarvis	GEO Secretariat		Pierre Defourny	UCL
Sophie Bontemps	UCL		Alyssa Whitcraft	UMD/Harvest
Sven Gilliams	VITO		Bettina Baruth	EC JRC
Chris Justice	UMD/Harvest		Leonid Shumilo	Ukraine Space Research Ins
Ben Koetz	ESA		Mykola Lavreniuk	Ukraine Space Research Ins
Mario Zappacosta	FAO		Andy Davidson	AAFC
Rogerio Bonifacio	WFP		Andy Nelson	U Twente
Michel Massart	European Commission		Hongwei Zeng	CAS-RADI
Miao Zhang	CAS-RADI		Inbal Becker-Reshef	UMD/Harvest
Jinlong Fan	CMA		Belen Franch	U Valencia

Summary of Meeting:

Over two days, the EAV WG (a sub-group of the Thematic Coordination Team on Earth Observations Data Coordination) met with the following big-picture Meeting Objectives in mind:

1. Clearly define the purpose, definition, and audiences of EAVs for GEOGLAM ("EAVs" for short)
2. Clearly define the framework for EAVs and where they fit in GEOGLAM's program of activities
3. Identify the EAVs themselves as well as "Stewards" for each to assist in defining their specifications
4. Develop a roadmap to completion and application – including processes, timelines, and plans for formalizing them for inclusion in policy frameworks.

The meeting was highly dynamic and discursive, with the majority of the two days being spent in a roundtable wherein each of the four objectives were addressed.

Actions:

Action	Point(s) of Contact	Due Date
Send report, EAV table, and framework to EAV WG	Alyssa & Sven	COMPLETE
Inform stewards of their tasks and timeline	Alyssa & Sven	COMPLETE
Establish an online workspace with a common template for completing the EAV work	Bettina	ASAP
Complete EAV table with what is *currently available* product-wise (links to products & publications)	Ian	March 2020
All to do their assigned work as stewards ☺	All	March 2020

Outcomes:

Meeting Objective 1: Purpose, Definition, and Audiences of EAVs for GEOGLAM

Purpose: There is a lot of distance covered between satellite data acquisition and decision making for policy. With respect to information about state, change, and forecast agricultural land use and productivity, GEOGLAM must provide a bridge to connect Earth observations to impact. Defining high-value EO-based products which are applicable across multiple decisions and policy spheres both demystifies the value of EO for policymakers and provides clear evidence to the world's space agencies of the traceability of their observations into decisions and policy.

Definition: Essential Agricultural Variables for GEOGLAM are Earth observation-based "building blocks" that in combination with one another or with other non-EO information provide insight into the "GEOGLAM Agricultural Indicators" – which themselves provide actionable information on the state, change, and forecast of agricultural land use and productivity (Figure 2). The EAVs can be measured or inferred from satellite data, and are supported through field data for calibration and validation. They may provide inputs to models, but are not model outputs themselves. They support the core work of GEOGLAM and its constituent communities, including national and global policy frameworks (e.g. G20 Action Plan and UN Sustainable Development Goals).

The EAVs are divided into two categories, the latter of which has two subcategories:

1. Core EAVs: These are higher-order variables which in-and-of-themselves provide meaningful information about agricultural land use and productivity. These may have more direct applicability or interest to non-EO usership.
2. Supporting EAVs: These are variables which generally require combination with other variables or additional context in order for their impact on or relevance to agricultural land use and productivity to be immediately understood.
    a. Those we articulate ourselves
    b. Those which explicitly leverage Essential Variables from other communities (e.g. Essential Climate Variables, Essential Water Variables, Essential Biodiversity Variables).

Audience for the Variables (as geospatial products): The Core EAVs are useful to EO and non-EO communities alike. The Supporting EAVs are useful principally to EO-communities.

Audiences for the EAV Framework:

1. Space Agencies & CEOS: EAVs taken together with the GEOGLAM EO Data Requirements Table clearly show the purpose of and need for satellite observations of agricultural land. It articulates not just what is currently available or currently feasible, but what we know as a community to be clear priorities of our usership.
2. Funding Agencies: Funding agencies can utilize the gap assessment (which will be an ancillary product of the EAV specification process) to develop solicitations.
3. Policy Audiences: To quickly understand the ways in which existing EO-methods or EO-products themselves can be integrated into policy frameworks for monitoring, verifying, or reporting with respect to agricultural land use and productivity.

4. Organizations seeking to understand where EO fits in a decision support system: This will help them understand what is feasible with EO with respect to agricultural monitoring. See Framework under Objective 2.

Meeting Objective 2: Framework for EAVs and Where They Fit within GEOGLAM's Program of Activities and Implementation

Framework

GEOGLAM has a number of activities which run from data to decisions around agricultural monitoring. A prior diagram (Figure 1) was created in 2015 to attempt to describe this workflow wherein coordinated, continuous acquisition of and access to multi-source Earth observation data flow through the development and technology transfer of best-practices for monitoring to operational systems, with the end goal being strengthened national, regional, and global agricultural monitoring systems. This diagram read from top to bottom (to signify satellites' view from above) and situated GEOGLAM within global concerns (food security, sustainable development, and climate change).

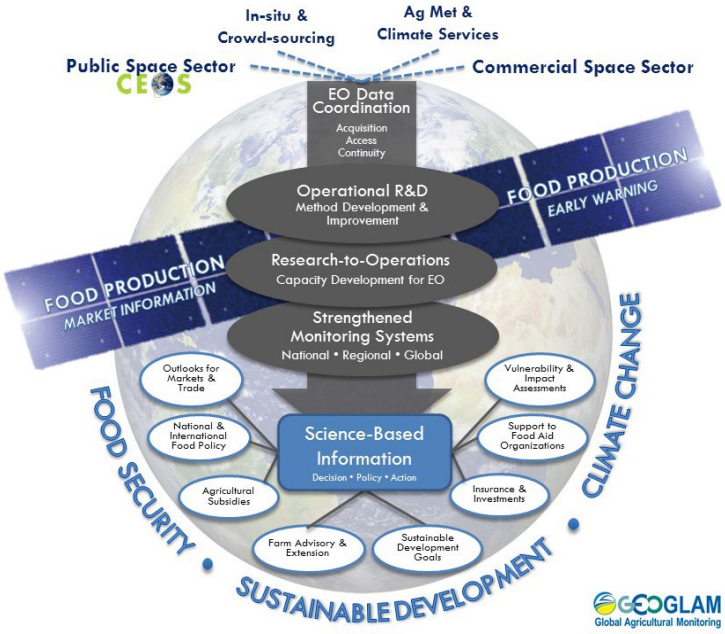


Figure 1: GEOGLAM Workflow Diagram, 2015

However, what was not clearly articulated were the EO-based variables and products that are being created and where they factor within any given decision support tool. To that end, GEOGLAM has additionally proposed the following "Data-Decisions Cycle" framework (Figure 2; which reads from bottom to top – building from large volumes of data to concise, actionable, sustained decisions), which identifies the relevant audiences and actors as related to GEOGLAM (left) engaged in each step of the

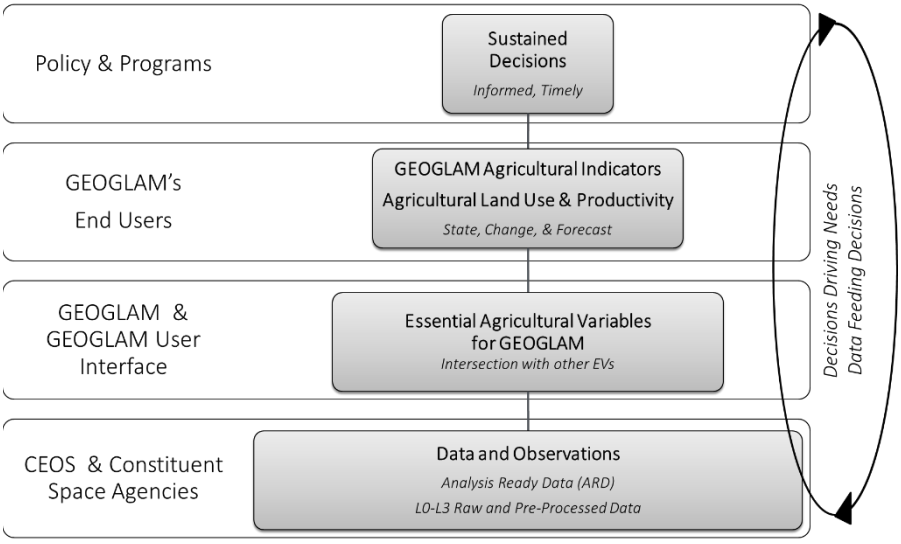


Figure 2: GEOGLAM Data-Decisions Framework, 2019

cycle. This clearly shows the two-way connections between observations – variables – indicators – decisions. EAVs for GEOGLAM, therefore are derived from satellite-based Earth observations and together or independently provide insight about state, change, and forecasting in agricultural land use and productivity, upon which GEOGLAM's own end users can conduct analyses as further input into policies.

EAVs as Integrators of GEOGLAM Activities

Due to their situation between observations and information for our core usership, EAVs aid in identifying both key observational requirements (and therefore gaps in both *in situ* and satellite observations) as well as priorities for operational research & development to improve these variables and their eventual policy relevance. They help drive the research agenda (for our operational R&D activity JECAM as well as for funding agencies seeking to support GEOGLAM) as well as plans for future missions. They also help identify which variables require a "Compendium of Best Practices" documentation, an effort under JECAM to document methods and practices which produce high-quality variables, which in turn feed directly into GEOGLAM's Capacity Development Team. And, of course, EAVs themselves feed the GEOGLAM and its community's activities – be it the GEOGLAM Crop Monitor Bulletins or the work of the global, regional, and national monitoring activities which comprise GEOGLAM.

Implementation:

A key question for these EAVs for GEOGLAM is how they are going to be implemented by the community. One of the questions raised during the discussion was on GEOGLAM's role with respect to their definition, production, and implementation. The following discussion question was posed:

- Is GEOGLAM
  - a) defining EAVs only?
  - b) a + providing best-practices + validation protocols?
  - c) a + b + going to generate some standard products?
  - d) some mix thereof (depending on product/variable)?

In line with the view that EAVs are the integrators of GEOGLAM activities, it was decided that for the EAVs we should go beyond only defining them. For some variables, the EAV WG agreed we should provide providing "best practices" documentation and validation protocols. Doing so would link the EAVs with (for example) the capacity development activities of GEOGLAM. For some variables, the EAV WG agreed that generating some as "GEOGLAM Standard Products" would support existing GEOGLAM activities such as the Crop Monitor.

We further agreed that a transparent process was needed for the endorsement of products generated by the broader Agricultural Monitoring Community of Practice, however this was beyond the scope of this first Workshop and has been placed on a timeline for late 2020 (see Timeline below).

Meeting Objective 3: List of Variables & Stewards

An initial set of EAVs were drafted in early 2019 in an EAV White Paper (last accessed 5 Nov 2019), but discussion at the May 2019 GEOGLAM Executive Committee Meeting, the group agreed there were variables missing and the framework needed revision (see new Framework in Objective 2). Through much discussion over this 2-day meeting, the following EAVs and their Stewards were identified.

A yellow highlight in the first table indicates highest-priority. Red text signifies a suggested steward that is not final (the person was not in attendance) or one that has not yet been identified at all.

Core EAV	Steward
Utilized agricultural areas mask	Bettina B., Ian J.
Annual Crop Mask	Bettina B., Miao Z.
Crop type map	Sophie B., Pierre D., Mikola L., & Hongwei Z.
Crop type area estimate	Sophie B., Pierre D., Matt H., Andy D., Bettina B.
Crop Yield estimation	Inbal B-R, Bettina B.
Crop yield forecast	Inbal B-R, Belen F.
Crop condition assessment	Inbal B-R, Miao Z., Jim V., Rogerio B., Mario Z., Felix R., Ian J., Leonid Z.
Water Productivity	Ben K., Jippe
Fallow mask	Not Determined
Rangeland Mask	Ian J. to explore
Rangeland Condition	Ian J. to explore

Supporting EAV	Steward
Current Crop Stage	Alyssa W., Andy N., Sven G.
Historical Crop Calendars	Alyssa W., Andy N.
Irrigation Timing	Thuy L.
Tillage (timing & type TBC)	Andy D.
Cover crop	Pierre D. & Andy D.
Crop rotation	Andy D.
Agricultural Burned Area	Chris J.
Field delineation	Sven; Alyssa to explore
Evapotranspiration	Ben K., Jippe, Dave J.
Seasonal Dynamics of Surface Water Availability	Sven G., Jean-Francois Pekel
Growing degree days	Jinlong Fan
Relative Humidity	Jinlong Fan
Incoming Radiation	Jinlong Fan
Agricultural Biomass	Andy D., support from Heather M. (Alyssa to check with Kaiyu)
LAI (ECV)	Andy D., support from Heather M. (Alyssa to check with Kaiyu)
fAPAR (ECV)	Catherine C.
Fractional cover	Juan-Pablo G.
Land surface temp (ECV)	Ben K., Leonid S.
Air Temperature (ECV)	Ian & WMO; Alyssa to ask ECMWF/NOAA/UCSB
Precipitation (ECV)	UCSB Climate Hazards Group
Wind Speed (ECV)	Jinlong Fan
Surface Soil Moisture (ECV)	Catherine C.
Root Zone Soil Moisture (ECV)	Catherine C.

Meeting Objective 4: The Way Forward + Policy Intersections

The session concluded with a discussion of EAV activity outputs, processes, and timelines moving forward. With respect to timelines, we targeted that a draft of the completed specifications of EAVs be

ready by early March 2020 in time to start socializing at the Committee on Earth Observations Satellites (CEOS) Strategic Implementation Team (SIT) Meeting in late March 2020, with the final versions as well as associated documentation ready by November 2020.

Outputs:

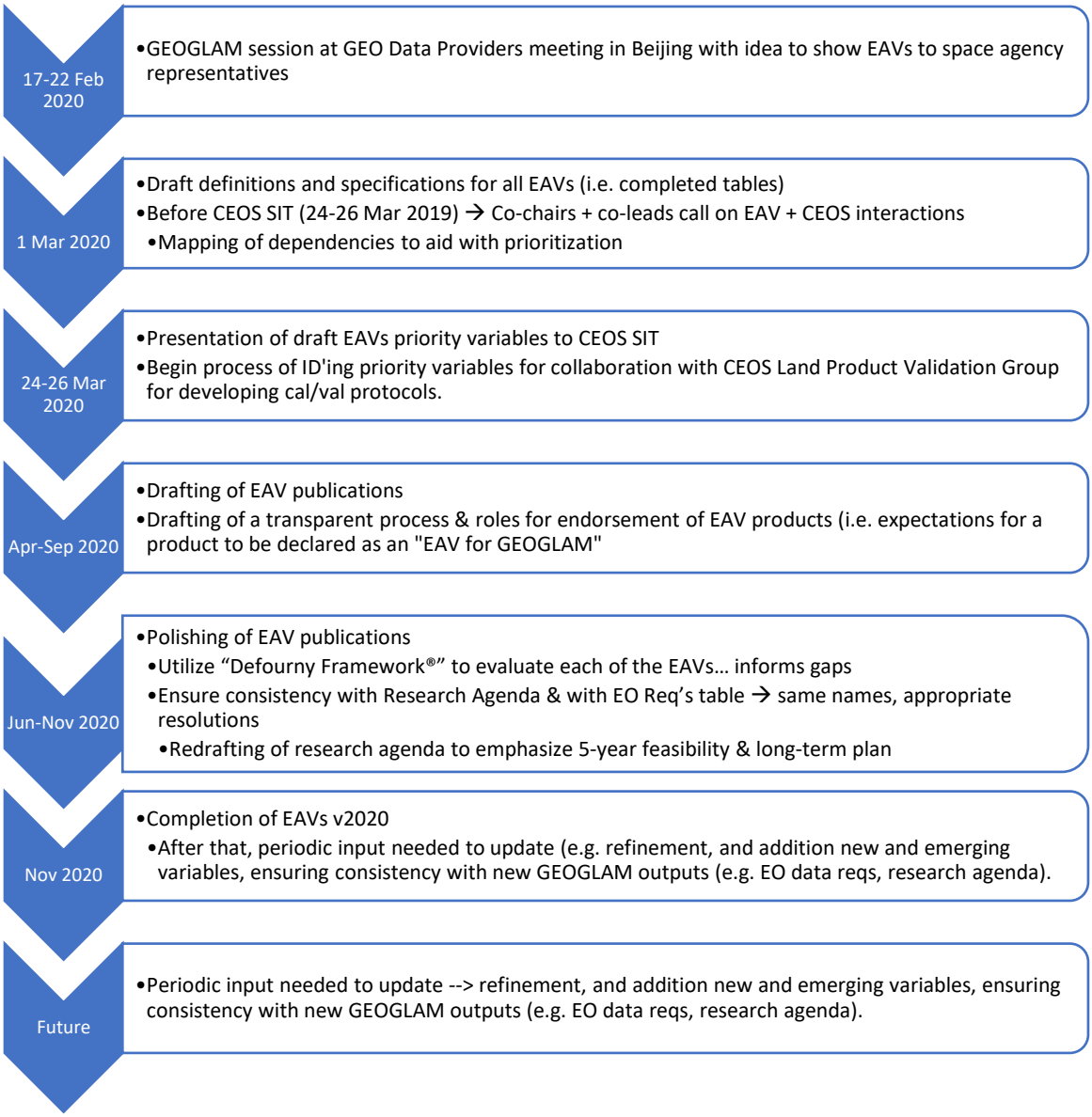
1. Community publication (peer-reviewed) and document for endorsement by GEOGLAM ExCom
    - Two versions: what is feasible now, what is ideal in the future
    - All definitions and specifications, example below:

EAV	Definition	Agricultural Land Type Covered (e.g. which crops?)	GEOGLAM Agricultural Indicator Category	Application or Policy Supported	Requirements			EAV Steward
					Frequency of Update	Spatial Unit	Product Uncertainty (national unless otherwise noted)	
Utilized agricultural areas mask	Binary determination of currently cultivated lands	all annual and perennial, including permanent (>5 years grass), nonpermanent, and managed grassland	Land Use	Land cover/use state & change; Broad brush monitoring, especially in early months, to narrow analysis, mask products for general assessment	Monthly, reliant on long term observations	field	10%	Bettina, Ian

2. Verification process for EAV products from the community
    - Proposed for the late 2020 timeframe.
    - Must address the question: *What does it meant to be an EAV?*
        - Adheres to GEO data principles
            - Ideally transparent, reproducible
        - Must have accuracy assessment or at least an explanation of sources of error/uncertainty if not quantified
        - Should be low latency

Further to the point on verification, the EAV WG decided that of course anyone could generate products for the variables, *but* in order to "control branding" around what is truly an EAV for GEOGLAM, we would create a webpage on the GEOGLAM website that announces itself as the formal list of GEOGLAM EAVs and we would make clear to funding agencies that we have a process for endorsement in order to make sure those developing products are accountable and contributing actively to GEOGLAM.

Timeline: Between November and March 2020, EAV co-leads Whitcraft & Gilliams will track completion and get buy in from GEOGLAM community and ExCom regarding EAV definitions and specifications. A more specific timeline is below:



Policy Intersections

The WG held a discussion about how to utilize the EAVs to support policy frameworks. It was generally agreed upon that – consistent with GEOGLAM organization and function – we should bring EAVs to the community at two levels:

1. At national/regional level: GEOGLAM has always viewed the development of national systems as the core objective toward developing the global system-of-systems that improves market transparency and supports food security. In the context of the UN SDGs, while there does exist a global organization (the Interagency Expert Group on SDGs (IAEG-SDGs)) tasked with establishing metadata for reporting on progress toward the SDGs, countries are individually responsible for developing and deploying their methods for agricultural assessment. We should therefore leverage these EAVs at the national or regional (in the case of political entities like the European

Union) level, in existing and new collaborations alike, as that is most consistent with and most supportive of GEOGLAM's continuous mandate.

2. At policy-level: Through groups like GEO's EO4SDGs, the IAEG-SDGs, or the G20 MACS, GEOGLAM should socialize the EAVs and their (and therefore EO's) applicability to policies. This is principally an outreach activity and a means of identifying additional resources for GEOGLAM's activities.

This is in line with the renewed priorities as set forth by our community in June 2017 and revised by Bettina Baruth et al. during the Tuesday 22 October 2019 GEOGLAM ExCom session:

- Develop **best practice compendium** (knowledge management system), technical guidance for operational implementation;
- Develop more **quantitative metrics** to meet evolving policy needs (markets and post 2015 framework; including EAVs);
- Contribute to post 2015 framework (SDG's Paris agreement, Sendai) bringing forward the EAV concept **demonstrating implementability** (mapping of EAVs to policy, examples)
- Update **EO requirements** to include data and services required to meet evolving needs (EAVs, CapDev Team);
- Capitalize on **open and big data** and information technology advances (cube, cloud processing) leading to greater transparency;
- Build **global monitoring capacity**, particularly through strengthening and **expanding regional networks** driven by national needs.
- **Capacity development and engagement at national level** to ensure access to and effectively use scientific information

EAV Working Group Photo

Attendees not pictured: Inbal Becker-Reshef & Belen Franch