Digital Agri Hub e-conversation series

Communication Toolkit

Challenges and Opportunities: Scaling Earth Observation in Digital Agriculture | Series 2: e-conversation #4

Starting date	Closing date	Number of posts	New members
4 March 2024	5 April 2024	46	53

Collaborating organisations

Hosted on the Digitalisation for Agriculture or D4Ag dgroup, this e-conversation has been run by the Digital Agri Hub in partnership with the Netherlands Space Office (NSO) and the Centro de Investigaciones en Geografía Ambiental (CIGA) of the Universidad Nacional Autónoma de México (UNAM).

E-conversation framework:

The relationship between Earth Observation (EO) and digitalization in agriculture (D4Ag) (including farming, fisheries, livestock production etc.) is significant, transformative, and ubiquitous. This involves different EO platforms (satellites, aircrafts, and Unmanned Aerial Vehicles), the use of relevant products and technologies, and other data collection methods to monitor various aspects of the Earth's surface, including agricultural land and water bodies. These observations offer a wealth of information about topography and land cover and use, crop performance, soil moisture and properties, soil organic carbon, biomass estimation in general, weather patterns, and other environmental factors crucial for farming as well as for those practicing fisheries and livestock husbandry (e.g. status of pastureland/ rangeland).

Digital and agtech solutions can complement EO to detect/characterize objects and activities when this cannot be done only via EO (e.g. See use of geotagged photos in the European Common Agricultural Policy subsidy system for supporting EO in the case of small plots, complex crop associations, and some farming activities).

When these two concepts are integrated, they may offer numerous opportunities to the agricultural sector. By analysing EO data within digital platforms, information service providers argue to offer producers the opportunity to make informed decisions about how best to manage their production endeavours. For instance, in some cases early detection of issues such as pest infestations or water deficiencies is made possible, allowing timely measures to be taken to mitigate risks. Solution providers claim that optimized resource management would become achievable as producers monitor soil moisture levels, temperature variations, and weather forecasts, ensuring efficient use of water and energy resources.

Still, not all seems to work that smoothly with scaling EO-based D4Ag products and services. Challenges in terms of frequency, timeliness, accessibility, affordability, transferability to farmers, especially small-scale producers in LMICs, are not to be overlooked. On the technical contents there is the risk that external advice based on the merger of EO with artificial intelligence and digitalisation, is becoming prescriptive rather than supportive of informed decision-making.

Summary of the e-conversation (ChatGPT assisted)

Users' considerations about EO-based D4Ag products and services.

The discourse surrounding the use of Earth Observation (EO) in digital agricultural technology services has been multifaceted and far-reaching, drawing examples from various regions such as Africa and Europe. While most cited examples pertained to crop management, participants noted a shortage of instances concerning other applications, particularly for fisherfolk and pastoralists.

EO and Digitalisation for Agriculture (D4Ag) share a strong technical foundation and employ similar digital infrastructure and delivery methods. However, the discussion revealed that many of the challenges encountered are primarily social rather than technical in nature.

Examples underscore the potential benefits of EO, including enhancing crop monitoring for efficient resource utilization and improving farmers' understanding of their environment. The integration of drone technology further amplifies these benefits, offering farmers actionable insights and facilitating decision-making processes.

Additionally, EO plays a crucial role in ensuring compliance with environmental and agricultural standards, as exemplified by the European Union's Deforestation Regulation (EUDR). However, challenges such as capacity building, governance issues, and user adoption persist.

One significant challenge highlighted in the exchanges has been the need for scalability and inclusivity in EO-based services, particularly in addressing the diverse needs of different crops and agricultural practices. Moreover, there has been a call to move beyond traditional cost-benefit analyses and consider the broader value that services provide.

Participants highlighted those technical challenges, such as data integration and connectivity issues, also hinder the seamless implementation of EO-based solutions. Legal and definitional ambiguities further complicate matters, raising questions about the regulatory framework and affordability of EO technologies.

In essence, while EO holds immense promise for revolutionizing agricultural practices, addressing the social, technical, and regulatory challenges is essential for realising its full potential and ensuring equitable access and impact across diverse agricultural landscapes.

Questions

1. If you make use of EO-based D4Ag products and services for your work, what are your important considerations? What added value and/or challenges do you experience?

2. Considering your use, experience and goals in relation to EO, should donors/investors place more emphasis on improving data, products and services based on EO namely for agricultural applications, not neglecting fisheries and pastoralism and agroforestry, or are these sufficiently mature (relevant, timely, recurrent, accurate, accessible) and ready to scale?

3. What aspects would you suggest that EO service providers could improve so as to support the acceptance, ease of deployment, usability, and benefit-sharing of EO-based D4Ag services, in your organisation (or organisations you know)?

4. How could international donor- and space agencies facilitate the advancements in EO-based services considering the needs, aspirations and challenges mentioned by stakeholders in the previous exchanges?

Perceived level of maturity of EO services delivered.

The discussion on whether donors and investors should prioritise improving EO data, products, and services for agricultural applications, agroforestry, fisheries, and pastoralism, showcased a certain degree of polarization among participants.

A contributor from Madagascar emphasised the ongoing necessity for investments from donors and investors, particularly in low-income countries where the maturity of EO applications may not align with those of more developed regions. He highlighted challenges such as regulatory frameworks that hinder the effective utilisation of technologies like drones, suggesting that public interventions could facilitate knowledge sharing on effective policies and regulatory models.

Conversely, a contributor noted that openly accessible and publicly provided EO and spatial data have become standard in Canada, notwithstanding issues about timing and spatial resolution. He pointed out that while high-resolution and near-real-time data are crucial for precision agriculture, users often resort to costly third-party providers due to limitations in publicly available data.

The discussion prompted reflection on similar challenges faced in low- and middle-income countries, particularly regarding the basic need to delineate land holdings and parcels for small-scale producers. This highlights the fundamental role of accessible and affordable EO data in enabling basic agricultural activities and monitoring.

Contributors further supported the prioritisation of improving EO data, products, and services, citing various reasons including the necessity for public intervention in developing spatial data infrastructures, interoperability standards, and impact studies. However, they acknowledged the role of private service providers, particularly in driving innovation, even in low and middle-income countries.

Overall, the discussion underscored the complexity of balancing public and private sectors’ involvement in advancing EO applications for agriculture, emphasising the need for strategic investments and collaborations to address existing challenges and unlock the full potential of EO technologies.

Perceived needed improvements for inclusive EO service delivery.

In the realm of D4Ag services, a prevailing sentiment suggests that EO innovations have largely been developed with a top-down approach, emphasizing technological success metrics. It is not entirely surprising, but some participants urged a reassessment and realignment of priorities.

One focal point of this discussion has been the identification of the data 'consumer'. There's a call for better classification, distinguishing between various roles such as data 'generator', 'consumer', 'processor', and 'beneficiary'. This ties into the broader need to comprehend the needs and preferences of end-users, particularly small-scale farmers.

Understanding the socioeconomic context surrounding the deployment of D4Ag and EO services becomes crucial. Factors like land tenure systems, financial accessibility, and market dynamics significantly influence users’ capacity to adopt and benefit from such services.

To truly understand the needs of small-scale farmers, there's the need to integrate local knowledge into EO-based D4Ag services. Local farmers possess invaluable insights into their land, crops, and climate conditions. However, bridging the gap between this local knowledge and the tech-oriented service providers remains a challenge. Many expressed concerns about the ease of deployment and acceptance of these services, often feeling sidelined by the perceived 'black box' nature of the digital solutions.

A significant dilemma emerged regarding the scale at which D4Ag services should be aimed. While service providers are tasked with delivering directly to farmers, the localised nature of agriculture necessitates solutions tailored to specific regions and contexts. The value of EO data is also under scrutiny, with calls for a focus on optimizing reliability and accuracy rather than merely processing images.

Ownership and privacy concerns loom large, with questions surrounding data monetisation, privacy rights, and appropriate pricing models. Transparency and affordability are key demands, alongside a push for standardised quality benchmarks.

Navigating these challenges requires a balance between farmer-inclusive participation and the efficient division of expertise. Practical suggestions include enhancing training and support services for users, establishing robust feedback mechanisms, fostering partnerships across sectors, and addressing connectivity issues in rural areas.

Ultimately, the goal is to create EO-based D4Ag services that are not only technologically advanced but also deeply rooted in the realities and needs of small-scale farmers, ensuring their accessibility, affordability, and efficacy in improving agricultural productivity and sustainability.

Perceived role of international donor- and space agencies facilitate the advancements in EO-based services.

The discussion highlighted several concerns regarding the role of international donors and space agencies in advancing EO-based services, particularly in agriculture.

Firstly, participants emphasized the overlooked challenges faced by female small-scale farmers, ranging from differences in crops and livestock to access to technology. There was a call for international donors and space agencies to address these specific needs in EO-based D4Ag services.

Additionally, questions were raised about the potential negative impact of poor accessibility to EO technology and automation, particularly in the Global South where many smallholders rely on agriculture for their livelihoods. Concerns were voiced regarding job displacement and the need for international stakeholders to consider the consequences and potential funding for this aspect. On the other hand, a representative from NSO, stated that according to their data, automation in digital agricultural services typically creates jobs, particularly benefiting young people, as seen in projects in Burundi and Angola. He recalled the positive impact on smallholders, who benefit from more efficient practices, potentially freeing up time for off-farm activities and additional income. While acknowledging the need to consider job displacement, he reported that NSO did not encounter negative examples in its experience. He expressed interest in learning more about any such instances to better address potential consequences.

The increasing politicisation of space also emerged as a concern, especially with private sector involvement potentially impacting the EO sector. However, there was scepticism about the extent of this impact on agricultural applications, given existing policies on open data and acquisition patterns.

Furthermore, some participants argued the availability of cheaper technologies like drones and LIDAR for similar functionalities offered by satellite based EO. While acknowledging the affordability and temporal resolution advantages of satellite EO, concerns were raised about the framing of cheaper alternatives as so much EO data is provided for free to the users by the European Commission, USGS and others. On the other hand, when it comes for data for a small parcel, drone generated very high resolution (VHR) imagery may be easier to access when compared to satellite VHR.

Despite these challenges, there was agreement on the need for donor support to reach female small-scale farmers and individual farmers in developing countries. Participants emphasised the potential impact at this level and suggested a rebalancing of donor requirements to address these specific needs effectively.

Overall, the discussion underscored the complexity of advancing EO-based services in agriculture and highlighted the importance of addressing gender-specific challenges and individual farmer needs in development initiatives.

Highlights

- The use of EO data is pervasive in the domain of D4Ag, nonetheless small-scale producers in LMICs face challenges accessing EO services in terms of affordability, frequency, timeliness, and locational relevance.
- While there is widespread evidence of the use of EO in the context of farming, existing EO-based services offer limited insights on the crops that the poorest farmers cultivate (e.g. millet, sorghum, or pulses).
- Unmanned Aerial Systems (UAS) offer on-demand, location specific, Very High Resolution (VHR) data sets which can complement satellite-generated equivalents.
- The use of Unmanned Aerial Vehicles (UAS) or drones, needs a clearly defined (possibly enabling) regulatory environment spelled out by the respective national aviation authorities (NAAs). Since the start of the deployment of UAVs substantial progress has been done in many LMICs, but some have still restrictive policies (e.g. Madagascar).
- Very high resolution (VHR) imagery is available at relatively high costs. This kind of imagery – if accessible at low costs – could be useful to delineate the holdings and parcels of small-scale producers (or equivalent in agroforestry, etc.) and in the future possibly monitor (activities, hazards, "performance", etc.) at the same scale. Still, a question lingers about "What level of precision of the EO data is actually needed by different categories, different purposes of data consumers?"
- In terms of adoption of EO-based services by small-scale producers the latter are unlikely to accept any form of tech if there is not a proven value, even if it is free. How do people [define] acquire value from the technology? When multiple providers offer differing services at different price points, this leads to confusion and hesitation on uptake and confidence in the veracity and usefulness of the data and associated services. EO data needs to be processed, visualized, and articulated in ways that make sense to farmers.
- Some areas like the development of spatial data infrastructures, interoperability standards, impact studies have still space for improvement and need national governments or donors' investments.
- Most EO-based applications are better matched with larger institutional level than with individual farmers in developing countries.

Recommendations resulting from the exchanges

- Contributors argued that a lot of focus is going into processing images for uses (agriculture, climate, biodiversity, water, etc.) without much focus on the actual quality of the products. There is the need for (i) a much more robust approach to collecting relevant open-source ground truth data so that the EO data/signals from images can be accurately calibrated to local conditions; (ii) quality benchmarks that set quality standards to which compare the product of any EO service provider to an objective reference. These are examples that specific images with specific ground truths lead to these EO data, and EO service providers could then reproduce these for demonstrating the reliability of their service. Such quality benchmarks are required for a wide range of different uses of EO data, and locations. This would ease the integration of EO data in D4Ag Services as the quality would be assured.
- EO service providers should focus on affordable, scalable and accurate data, which is then translated into value (information) by local partners. These local partners could be already existing farmer consultants or extension services, or research institutes, or private companies, not necessarily experts in EO data but with a good understanding of the farmer needs and requirements, and ideally already having an existing partnership with the farmers.

- Incorporate local knowledge and traditional farming practices into EO-based D4Ag services. Local farmers often possess valuable insights about their land, crops, and climate conditions.
- With a specific focus on female small-scale producers, donors should make specific efforts to support projects (having a duration exceeding the typical 3-4 year period) which could ensure that the EO-based solutions are considered as a culturally acceptable, location specific and reliable reference, which facilitate informed decision making, decrease the operational (input) cost and operational complexity.
- In order to facilitate adoption EO-based D4Ag services by small-scale producers there is the need for localised solutions responsive to regional differences in climate, soil, cropping patterns, and agricultural practices; customizable solutions adapted to different geo-agricultural contexts.
- Organise and run capacity-building programs specifically focused on enhancing users' abilities to interpret and act upon EO data insights. Practical guidance on how to translate EO-derived information into on-farm decisions.
- Governments to consider making digitised EO data publicly available as Digital Public Goods (DPG) like in India.
- One potential application of EO is in weather and calamity prediction. While there are existing satellites that already perform this task, there is a need for improved modelling and prediction specifically for small-scale producers.
- EO has the potential to detect trends such as Locust swarms or Fall Armyworm outbreaks, enabling the development of early warning systems. Likewise main staple crops (e.g. rice, wheat, or maize) and high-value cash crops (e.g. coffee, cocoa, or cotton) would benefit if prioritised for disease detection.

Shared Resources

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- India’s National Vegetation Monitoring: https://vedas.sac.gov.in/vstatic/vegetation_monitoring/index.html
- India’s Thematic maps: https://www.nrsc.gov.in/EOP_ThematicMaps_overview
- India’s Soil Data Heat Maps: https://soilhealth.dac.gov.in/home
- Global Drone Regulations Database: https://droneregulations.info/index.html