Collective Action on Inclusive Digital Ag - Briefs

The Partners in the Collective Action on Inclusive Digital Transformation of Agriculture recognize that the key driver towards the full realization of the benefits of the digital transformation of agriculture is the **inclusion of farmers in the design and governance of digital solutions, and in the negotiation of related data practices and business models**.

We need to strengthen the recognition of **farmers as central actors of innovation and innovators themselves**, generators of valuable agricultural knowledge and holders of intellectual property rights, not just recipients of others' solutions, knowledge, and data.

https://www.gfar.net/content/gfar-collective-action-inclusive-digital-transformation-agriculture.

Brief 2

FARMERS & DATA - Access to External Data for Smallholder Farm Use

1. Importance of data for smart farming

"Digital food systems" is probably the most general term used to refer to digitalization of all aspects of the food systems, from farming to supply and value chains to government policies to extension services to markets to consumption and health. "Digital agriculture" is a term sometimes used with a similar meaning, but normally used to refer to a slightly more limited subset of the digital food systems, closer to the farming activity: smart/precision farming, digital advisory services / e-extension, open data for agriculture, value chain traceability.

This brief focuses on digital agriculture, more precisely on the importance of data for "smart" farming and the related challenges for smallholder farmers.

Data is an essential dimension of digital agriculture: the "smart" aspect of digital solutions, the one that automates decisions and optimizes efforts, depends on the underlying data: without data (from the field or from external sources) digital solutions cannot be smart.

The digital transformation of smallholder farming is believed to improve quality, productivity, profitability and sustainability of farming practices through the intentional use of big data insights that allow farmers to "**have the right data, at the right time, to make better decisions**". However, there are several challenges limiting smallholder farmers' access to necessary data, which is the topic of this brief. This brief will overview the nature of external data needed by farmers ("imported" data) and the sources of such data before addressing the challenges associated to accessing imported data and some potential recommendations.

The graph below summarizes the streams of data in smart farming.

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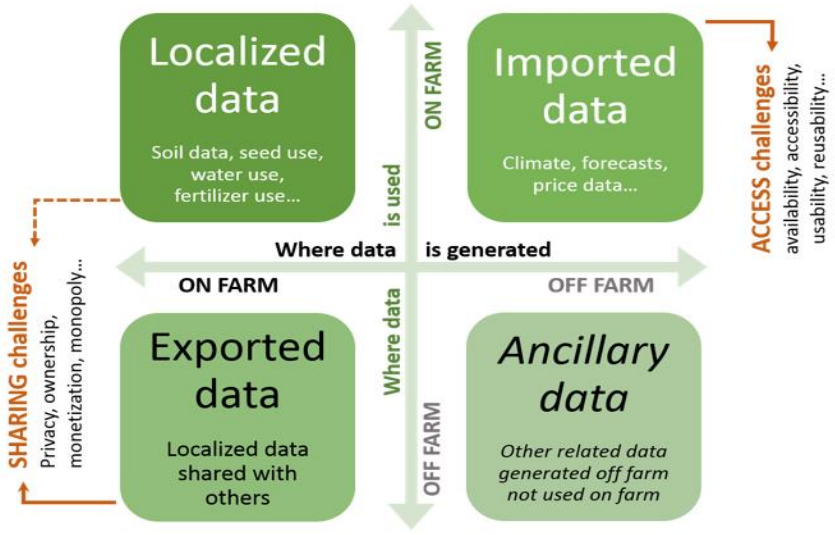

Figure 1 Streams of data to and from the farm. Maru et al. 2018.

The topic of 'exported' data (or data generated by digital technologies on the farm and shared with other actors) is explored in brief n. 1.

Imported data will be the focus of this paper, addressing the following questions:

- What are the barriers that smallholder farmers face when trying to access imported data, specifically from public sources?
- How can these barriers be overcome?

2. Typical sources of data needed in smart farming

Public sector actors, such as agricultural, economic and statistical agencies, collect, aggregate and share relevant data within this sector. This data may be simply collected and held, but also may be shared with other government agencies to assist in policy-making decisions or opened and disseminated widely (Ferris 5). A substantive part of this data is or can be extremely useful for farmers, although in most cases it is not immediately usable by them and not designed for their direct use.

Access to this data for farming purposes is normally through digital services: there is increasing interest in leveraging digital technologies to facilitate access to these data, in particular via "open data" arrangements. (Jouanjean 20).

Example: In Uruguay, the Ministeria de Ganadería Agricultura y Pesca collects, aggregates, and publishes data on land and crop prices. They are not the only government agency to do so. In fact, many government agencies around the world are involved in the collection and analysis of a wide range of data relevant to farming from weather data to property ownership to market prices. These datasets can be used by farmers to better inform their practices, and more and more of these datasets are being made open access.

Many countries have adopted or signed onto international agreements that emphasize the importance of policies that make open and reusable public sector data. For example, the 79 members of the Open Government Partnership (OGP) (Figure 2) are asked to uphold "an access to information law that guarantees the public's right to information and access to government data is essential to the spirit and practice of open government". Additionally, in 2004, the nations of the Organisation for Economic

Cooperation and development (OECD) signed a declaration that agrees to make the data of all publicly funded research publicly available. The Open Data Charter, which has been adopted by 22 countries, invites governments to make public data open by default, timely, comprehensive, accessible, usable, comparable, and interoperable.

Nevertheless, it is important to note that not all governments own the data that is most useful to smallholder farmers. Other important sources of open data are scientific research, non-governmental organizations, international organizations, and private companies.

For example, the National Aeronautics and Space Agency (NASA) adopted the Earth Science Data Policy in 1991, at which point they began providing full and open access to their data with no additional costs and in a time sensitive manner (Jellema 14). Many space agencies have followed suit since then, making more satellite data available and accessible to the public. In 2010, Google was able to partner with NASA, utilizing their open data policy, to develop Google Earth Engine which allows non-experts to process, use, and understand satellite imagery collected by NASA (Jellema 14).

The opening of space agency datasets has allowed for much cooperation to develop useful services. For example, USAID developed the Famine Early Warning System Network (FEWS NET) based on satellite and weather data collected from international space agencies (Jellema 16).

International organizations are also independently a good source of open data as many of their donors now require open data publication – although much of this data is focused on project accountability (Jellema 24). A few examples of international organizations that have made their datasets open to the public include the World Trade Organization, the Food and Agriculture Organization of the United Nations, the World Bank, Open Data for Africa by the African Development Bank. There are also many non-governmental organizations (NGOs) that are developing technologies and services related to open data sharing. For example, eLeaf utilizes open satellite data to estimate crop water use and growth (Jellema 17).

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The multitude of public data sources makes the role of all intermediaries (solution providers, extension agents, farmers' organizations) key in making sure that relevant data is delivered in usable form, normally in the form of digital solutions or advice to farmers. In Table 1, you will find a summary of public data sources with a focus on government sourced data and the utility of each type of data to farmers.

Table 1: Examples of Public Data Sources and their Uses (GODAN, "Government Open-Up Guide for Agriculture")

CATEGORY	TYPE	DESCRIPTION	FARMER USE	EXAMPLE
Administration and legislation data	Agricultural law & regulations	Policy and legislation texts.	Inform their position on subsisdies, legal restrictions and other policies.	Kenyan government webportal to access all Kenyan laws as PDFs.
	Official records	Lists of items, people or organisations that are registered, permitted or restricted due to legislation.	Make more sustainable choices and minimize misuse and fraud.	Californian Department of Pesticide openly shares list of registered pesticides.
	Financial data	Financial management data of the government.	Provide feedback to government on tax expenditure.	Many countries such as Canada, USA, Taiwan, and Uruguay share this as open data.
	Rural development project data	Description of government-funded rural development projects.	Provide feedback on project expenditure and implementation.	UKAID shares this type of data on an interactive website.
Socio-economic data	Land use & productivity data	Describes cultivated area, crops and yield in different regions.	Used to plan crops to be planted.	Visualization of international agricultural productivity collected by Knoema World Data Atlas.
	Value chain data	Describes companies and organizations involved in the value chain.	To better understand competitiveness of their farm and adjust practices.	Dutch webportal aggregating data on agricultural trade, farm income, employment, prices, etc.

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	Infrastructure data	Describes national networks, condition and maintenance.	Supports farmer decisionmaking in trade.	Rwandan geoportal with information on class 1 roads.
	Market & price data	Location of markets and market prices.	Informed decisionmaking and negotiations.	Crop and livestock pirces collected by the statistical agency in Kenya.
Natural resources, earth and environment data	Meteorological data	Describes surface weather (forecasts, historic archives, etc.)	To better plan farming activities.	Global Forecasting System (GFS) of the NOAA provides global weather forecasts as open data.
	Elevation data	Describes elevation of terrain (slope, aspect, etc.)	To receive better advising when adjusted to topography.	CGIAR open dataset using a refine SRTM elevation model.
	Hydrological data	Describes ground & surface water.	Adaptation to water availability.	Global dataset that simulates water flow and precipitation using HYPE model.
	Soil data	Describes soil characteristics and classes.	Better crop selection, input use and management.	Overview of global, regional and national soil maps collected by the FAO.
Agronomic data, agricultural technologies	Production advice data	Land management advice from extension services and research institutes.	Improve farming practice, higher yields and increased sustainability.	Information sharing system developed by the Tropical Agriculture Platfrom (TAP).
	Pest & disease data	Distribution of pests, diseases & their treatment.	Informs strategic use of pesticides and rapid action.	Diagnostics for plant diseases worldwide through the Plantwise App.

2. Challenges in accessing relevant data for smallholder farmers

While imported data offers the possibility to support and improve decision-making in smallholder farming, it also comes with challenges of availability, accessibility, and usability.

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Availability

Simply put, a major issue with imported data is that in many countries it is unavailable – more specifically, it is not digitized. The digital divide between the developed and developing world represents not only a lack of means to buy technology, a lack of adequate infrastructure, but also a lack of digital data. Many governments also lack the capacity to keep collected digital data up-to-date or to ensure its reliability: in Jamaica, there are 178,000 registered farmers and yet, there is less than 150 inspectors responsible for agricultural data collection. Finally, the availability of data depends upon statutory bodies to oversee data management and dissemination – which are lacking in many countries. In many cases, the unavailability of national data pushes farmers to depend on data from abroad.

Accessibility

The existence, the availability of data does not guarantee accessibility, meaning the ability to access and retrieve the data from where it is stored. Data use can be limited by a variety of legal rights from intellectual property to copyrights to trade secrets to patents. For example, if a farmer is attempting to access data from another country, the data may be restricted by regulatory and legal differences.

Similarly, it is well known that the private sector retains most of the highest-impact datasets known as high-value data like weather forecasts, market data, or pest early warnings,. Much of these datasets are inaccessible because there is a lack of incentives for them to be shared publicly, and simply a lack of public alternatives for similar high-value data.

To access imported data, one needs the adequate technology and technological infrastructure. Basic access to raw data, which is not the most useable form of data for farmers, already requires Internet connection. Despite being responsible for about half of global food production, smallholder farmers rarely have access to the telecommunication and internet infrastructure needed to benefit from digital agriculture. In 2015, only 10% of the world population had fixed broadband internet connection, and even though 47% could access mobile internet, 95% of that coverage was only at a 2G speed. Even when these internet and telecommunication services are available, cost of use remains costly, and thus digital data remains inaccessible.
Besides, rather than raw data, farmers need information, insights and advice from data, which comes through software or digital advisory services that make data applicable. This brings with it the additional challenge of data being accessible to, and technically usable from, the software or service provider.

Finally, access to data and insights comes at a cost, one that is often too high for smallholder farmers. In this way, well-resourced actors are benefiting from the insights of digital agriculture while smallholder farmers are left in the dark, dramatically increasing the digital divide.

Use and relevance

If data is both available and accessible, then what remains to assess is its usability. Usability is the ability of the data to meet the needs of its audience. For example, satellite data is a commonly used form of open public data – yet the spatial resolution often makes this type of open data unusable for smallholder farmers whose fields only represent a tiny fraction of the dataset. Other barriers to use inherent to the data are when data is of low quality, outdated or poorly structures. Finally, publicly available data is rarely real-time data, which is of the highest value and applicability. This is even more true for digital agriculture in which the right data *at the right time* is key to decisionmaking.

Furthemore, even if data is technically "usable," it often remains "unreadable" considering the lack of digital culture and literacy in the agricultural sector. Beyond digital literacy, language, and literacy itself must be considered. If the digital insights are translated into non-numerical information, that information may not be usable by a farmer if it is not disseminated in a familiar language or mode of communication.

Finally, imported data is unusable if it does not meet the needs of smallholder farmers. To this point, it is notable that most aggregated data insights are prepared for industrial export agriculture which is a reality far from that of smallholders. Aggregation of large datasets to draw insights for industrial agriculture inherently leads to a loss of some information as it becomes more general – a loss of information that could be key to smallholders. Additionally, data loses its utility without context, without knowing the settings and conditions underwhich the data was produced. For example, rainfall data needs to be associated to a specific crop, and particular time of the year to become useful for farmers. Similarly, the scale of observations needs to be considered when making datasets available to smallholder farmers. For example, satellite observations may be irrelevant to smallholder farmers because the size of cropping areas is much smaller than the observed area (Jellema 17).

3. Proposed good practices and business models

Historically, the government has had a strong hand in agricultural development, and once again, they have a role to play in ensuring that all farmers benefit from the digitalization of agriculture. The following recommendations attempt to address the discussed challenges and create a central role for government.

Availability

To begin with, more needs to be done to ensure the availability of data wherever possible. Governments can clean, update, and openly publish current data on the internet for easy access. It is also recommended that they develop or reinforce a national infrastructure to promote responsible data updating and publishing going forward. Steps like these have been taken by the Edo State Government in Nigeria in 2015 who published several agricultural datasets in an open-data portal, making them available to smallholder farmers across the state.

Accessibility

As has been discussed, it is common for farmers to seek out available data from other nations. To facilitate the flow of knowledge across borders, it would be best if governments at an international or regional scale develop a cooperative regulatory framework. The Food and Agriculture Organization at the United Nations is currently mapping the "relevant existing policy environment that can be sometimes fragmented, within the agriculture and information sectors".

As for the private sector, privacy, security, and proprietary issues limit access to corporate data. Corporations would have to be persuaded to publish their datasets under an open license for the public good. This is a project that the United Nations Global Pulse is working on. Other recommendations to this effect include developing a social certification scheme to incentivize corporations to share their data and developing public-private partnerships in which compensation for shared datasets could be considered. Finally, it is recommended that governments enforce the policy that the data from publicly funded research needs to be published as open data.

The digital divide needs to be considered when data insights are disseminated and shared with the public. The farming community is diverse in their technological resources and abilities, and information

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dissemination needs to be done based on which information systems are available and used by smallholder farmers in particular. In 2014, there were 122 services worldwide offering agricultural advice services through mobile technologies. Knowledge translation needs to be adapted to the current state of communication infrastructures while, simultaneously, governments invest in the coverage and quality of information and said communication infrastructure. More specifically, rural communities need access to mobile telephony and broadband internet. Again, public-private partnerships could be utilized to invest in infrastructure development, and governments could provide credit or subsidies for the acquisition of technological equipment on small farms.

To give smallholder farmers access to digital data and agricultural insights, it is recommended that governments develop an independent, farmer-centric data repository that would act as an alternative to private sector data usage or as an introduction to digital agriculture. This has begun in Canada, where AgBox is a farmer owned data cooperative that is partially funded by the government. The cooperative offers farmers a platform on which to store their data and that connect them to other services useful for precision farming.

Use and relevance

Available and accessible data needs to be made usable – in the smallholder farming context, this means that the data needs to be translated into actionable, location-specific information that can be combined with pre-existing knowledge and insight. The data also needs to be contextual meaning that farmers need to be able to learn about the circumstances under which the data was collected as this will allow them to assess whether it is applicable and relevant to their own situation. When publishing insights from big data, one must consider how raw data, being more granular and specific, can be more informative to smallholder farmers who deal with greater context-driven factors (Jellema 20). Raw data should be published alongside aggregated data so that the more specific insights can be teased out for the smallholder context.

Data needs to be adapted to the digital culture and literacy of the regions in which smallholder farmers operate. Intermediary actors are thus necessary to take the data and information that has been made open and translate it into usable knowledge. Cooperatives and farmer organizations are ideally situated to take on this responsibility with some support and training of advisers from the government. Simultaneously, farmers organizations could organize to build the capacities of members to use data-driven information – providing them with the knowledge, skills and technology necessary to these ends, with the support of the government. The non-government organization the Busoga Rural Open Source and Development Initiative (BROSDI) embodies these efforts to translate data into knowledge for smallholder farmers. Other options to strengthen rural capacities to interpret and use agricultural data include setting up trust centres at different levels as a form of low-cost rural advisory service, as well as including digital agriculture in the curriculum at higher education centres. Additionally, pictorial charts or video documentaries have been highlighted as useful modes of communicating new information. A final recommendation to improve usability of data is to develop more user-friendly platforms that translate the data into actionable information.

In order to ensure relevance of data and associated services, there is a need to co-design and collaborate with smallholder farmers early on in development. These collaborative practices are commonly known as responsible innovation. It is recommended that governments and private sector actors invest in developing digital technologies that are designed for and incorporate the knowledge of smallholder farmers, as opposed to the more common target audience being industrial farmers. Some examples of projects that have been highlighted as useful to farmers include agro-climatic forecasts, early warning alert systems for threats and pests, platforms that increase knowledge about the various actors in the agriculture value chain, and microfinancing services to name a few. There is a

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particular need for real-time and time-sensitive data that can be updated and shared quickly across networks (Farm Data Management MOOC 2.2). These types of data are often collected by private sector services and should be acquired or co-developped by government agencies to better serve the public (Farm Data Management MOOC 2.3).

Conclusions

Combining imported data with smallholder farmer knowledge allows farmers to improve decision making and agricultural output more generally. However, there are numerous barriers that impede availability, accessibility, and utility of imported data for smallholder farmers. Many recommendations have been proposed that address each of these barriers specifically. In the large picture, working to make imported data more open and more tailored for smallholder farmers has the potential to increase food security and nutrition around the world.

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