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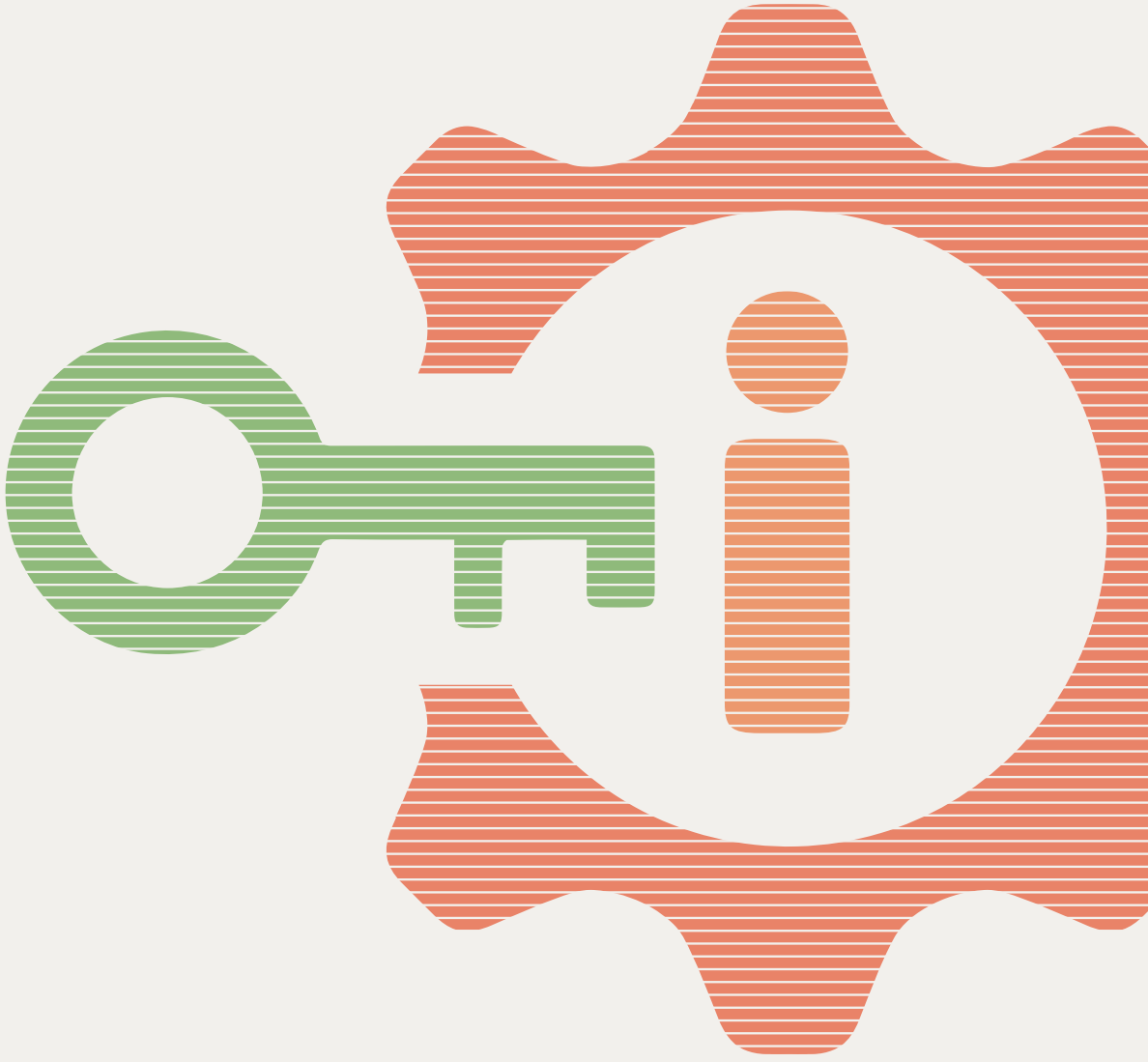

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IFLA
P.O. Box 95312
2509 CH Den Haag
Netherlands
www.ifla.org

Contact: DA2I@ifla.org
Website: https://DA2I.ifla.org

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Chapter 3:

A2I for Sustainable Agriculture

How access to information can help end hunger and promote nutrition

Thomas Baker, Ruthie Musker
Dublin Core Metadata Initiative

The aim of Sustainable Development Goal 2 (SDG2) is to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture" (UN, 2015). Eliminating hunger and all forms of malnutrition cannot focus only on increasing crop yields. Attention must also be paid to increasing food quality and nutritional value, raising smallholder farmer incomes, empowering women, supporting ecosystem resilience in a changing climate, maintaining genetic diversity, and improving access to healthy food for everyone. These crucial components to the elimination of hunger are outlined in the SDG2 subgoals.

Currently, there are approximately 570 million farms in 161 countries. Of these, 13 percent are in lower-income countries and 36 percent are in lower-middle-income countries. Farms less than two hectares comprise 12 percent of the world's agricultural land, and family farms make up 75 percent of the world's agricultural land (Lowder et al., 2016). Forty-three percent of the agricultural labor force in less developed countries is made up of women (FAO, 2012). If sustainable agriculture and SDG2 are to be achieved, smallholders, especially women, and low-middle-income farmers must be able to access, analyze, and apply information to their production systems. Improved access to information for farmers increases the likelihood of achieving the SDG2 and its subgoals.

Open data lies at the heart of improved access to information for farmers. The Global Open Data for Agriculture and Nutrition (GODAN) initiative advocates for the proactive sharing of open data to make information about agriculture and nutrition available, accessible and usable. GODAN, along with its network of more than 500 partners who also advocate for open data, believes that open data on agriculture and nutrition is crucial to the achievement of the sustainable development goals, especially SDG2. Open data to achieve SDG2 has two aspects: 1) Farmers need open data and access to information on modern farming methods, on appropriate inputs such as seeds and fertilizers, on market opportunities, prices, weather, environmental protection, health, agricultural laws and regulations and, where appropriate, on how to apply for subsidies. To find and use such information, farmers need access to, and training in, information and communication technology (ICT). 2) Global initiatives, governments, foundations, industry, NGOs and research institutions will be able to use open data that smallholder farmers provide to make positive decisions for the food system and to ensure food security, while holding one another accountable for SDG2 monitoring.

570.000.000 farms in **161** countries, of which **49%** are in lower or lower-middle income countries.

Open data and open access to information (A2I) take several forms. It is often said that the best technology is the one that is most available. Though the internet has become the primary source of data and information in today's increasingly urban world, information is often the most helpful for farmers in rural areas when available as accessibly presented leaflets, radio shows or podcasts, videos, or webinars, or presented at community events with opportunities for interaction. Information also needs to be available in the language of farmers, which is often a local or minority language. This chapter argues that open data and open A2I are crucial for achieving Sustainable Development Goal 2: Zero Hunger. As defined in this report, A2I entails the rights and capacity to use, create, and share information in ways that are meaningful to each individual, community, or organization. We focus on challenges surrounding SDG2 and how data and information can overcome these challenges.

3.1 Obstacles to information access

Although a tremendous amount of open data and useful information exists online, farmers in less developed countries lack the education, ICT skills, and access to computers and connectivity needed to use the internet effectively to improve their livelihoods. Family farms often rely on inefficient and unprofitable methods and often operate at subsistence levels. Many farmers speak only a local language and some are non-literate. They lack access to information about markets and new farming methods that might help them improve productivity. Outlined below are several obstacles that smallholder farmers must overcome in order to not only receive the correct information, but translate that information into an actionable decision.

Access to print materials. Print materials remain the most easily accessible way to browse and consume basic information. In a time of rapid change and technological development, there is continual output of new and updated print materials. Faced with limited budgets, the providers of information to farmers and other rural citizens must choose their materials carefully. In areas that lack libraries and newsstands, printed materials can be provided through information tables set up at markets or fairs, or taken out to remote areas in traveling library vans.

Access to web materials. With the most relevant and up-to-date information available now on the web, it is increasingly important to deliver print materials "on demand," such as when a farmer downloads and prints maps using computers and printers provided by a library instead of visiting a government agency in a distant city. Taken to its extreme, print-on-demand can be offered from traveling information tables or library vans with mobile internet connections.

Access to computers. Many farmers lack basic access to computers. This is in part a very practical question, especially where electricity is unreliable, and it has also to do with lack of ICT education (see below). Libraries, and library-like rural information centers, can provide public-access computers, if necessary powered by solar panels or generators. But in an age where ordinary smartphones, each with more computing power than the 1969 mission to the moon, will be in the hands of 80 percent of the world's population by 2020 (The Economist, 2015), mobile phones will clearly become more crucial to farmers. They're needed not only for accessing information, but for creating content and for interacting with expert help services (see below).
Face-to-face access to experts. Information is sometimes best digested not when consumed in silence, but in face-to-face situations that invite questions. Examples include plant-clinic tables set up in village markets and presentations hosted at libraries or at fairs. Screenings of video documentaries or webinars, whether in libraries, tents at fairs, or mobile vans, provide opportunities for discussion. Farmers may find a long trip to a nearby town worthwhile if they can meet other farmers and ask questions. Face-to-face events are especially helpful to non-literate farmers.

Family farms cover **75%** of the world's agricultural land (Lowder et al., 2016).

Access to information tailored to local needs. One might assume that farmers who grow the same crop or live in areas with similar climates can benefit from the same technology, but other factors, such as culture and social structure, must be considered if technological solutions are to be sustainable.

Access to information in local languages. Farmers are more likely than other population groups to require information in local or regional languages. Some projects have developed video documentaries on farming methods explained by farmers in their local language, developed PowerPoint presentations, or repurposed the presentations as leaflets for distribution from mobile information tables or at farmers' meetings.

Access to facilities and training for creating videos. Lessons and experience about topics such as farming methods, health, accounting and taxes, and available subsidies can reach wider audiences in the form of documentary videos and educational webinars. To produce such materials with today's technology, it is enough to have a laptop with video production software, some digital cameras and voice recorders, a projector and screen. Training is required to use such equipment effectively.

Access to ICT training for farmers. To find and access up-to-date information on their own, to communicate with other farmers or with experts, and to manage family finances more efficiently, farmers are helped by training in internet search, email, and spreadsheet software. More advanced ICT training topics include video production for documenting farming practices and desktop publishing for creating leaflets and marketing materials.

Access to information in remote areas. Farms in rural areas do not have the same resources as those who live close to urban centers. Farmers in remote areas can sometimes be reached by radio broadcasts; however, technology can also be brought to the remote villages with mobile buses or vans. Such mobile units are typically equipped with computers, mobile internet, and collections of selected print materials. Some mobile units are used for traveling computer labs or for information tents at agricultural fairs.

Access to information and assistance with markets. In order to ensure a sustainable income and fair prices for their products, farmers must receive correct access to markets and market information either through a smartphone, audio message, or another method that is culturally appropriate for the farmer.

Training for volunteers. In the low-resource conditions of many farming communities, information access initiatives typically require the mobilization of volunteers, and volunteers must also be trained. Examples include the training of volunteers in using smartphones to transmit information from the field for diagnosis by experts, and the training of facilitators for workshops, information evenings, and computer labs.

Building partnerships. Partnerships are essential to achieve SDG2. Local initiatives, community libraries, national libraries or library associations, local or national agencies, extension services, NGOs, research institutes and universities, international organizations, industry, and governments must work together for success and sustainability.

3.2 Initiatives to increase farmers' access to information

The following examples show a range of A2I initiatives that have improved agricultural production and farmer livelihoods through available technology. A2I is important to the farmer at all stages of agricultural production. Information can be used to decide which crops to grow and how to price them for the market; and it is essential to promoting the importance of nutrition. Specifically within crop production, farmers face various challenges that A2I can improve, including changeable weather, plant health, pests and diseases, and access to a consistent water supply. Farmers should be able to record their own data to plan for the future, and may require ICT infrastructure or internet connectivity, and sometimes even electricity. Even after farmers have access to mobile phones and internet connectivity, they require training and extension services, in local languages, to build capacity.

3.2.1 A2I for land rights

Improving transparency of land rights with a digital registry (Rwanda). In Rwanda, farmers did not have exclusively named land rights, resulting in conflicts among neighbors and time lost to resolve disputes. The government of Rwanda has developed a nationwide, digital-based land registry system, Rwanda Natural Resources Authority (RNRA), which is both online and machine-readable. RNRA is the first large-scale land registration program of its kind in Africa. The system has improved income security for many rural citizens, stimulated a new wave of rural development, improved access to credit, and promoted investment in new businesses. Due to RNRA, all records are digital rather than physical, saving time and money. Mortgage approvals are automatically recorded, tax gathering is streamlined, and 84 percent of land has identifiable owners. This digital registration system plays a key role in creating social cohesion and helping to increase agricultural productivity. RNRA has resulted in reduced conflict, and more time for strategic development. Additionally, women can formally register as landholders (GODAN, 2016).

The Haller Farmers App uses 60 years of data to help farmers increase yields during inconsistent weather. 80% of the farmers involved were women, 42 000 people in total were impacted by the app.

3.2.2 A2I for decision-making and farming practices

Smartphone app for decision-making (Kenya). In Kenya, the Haller Foundation has developed the Haller Farmers App, which has organized 60 years' worth of farming data and expertise into a usable format for smallholder farmers. The app draws data and results from a local test farm. The information is provided openly in both English and Swahili in text form, with Swahili also available in audio format. The Haller Training and Demonstration Farm trains farmers on innovative agricultural techniques for sustainable living. Farmers receive face-to-face advice and information tailored to their local needs. The app has taught farmers how to increase their yields during inconsistent weather. One farmer has begun to terrace his crops, which are now surviving both rains and droughts. Haller also helps farmers to combat pests using organic pesticides that do not damage the soil, and to build dams to ensure consistent availability of water. Numerous success stories show that because farmers received advice on optimizing farming practices through the Haller app, they have excess money to feed their families and can send their children to school. In 2015, 42,000 people were impacted by the Haller Foundation, 80 percent of the farmers were women, the app had 10,000 unique users, and 1,724 farmers were trained (GODAN, 2016).

Helping farmers with satellite data and extension services (Uganda). The Market-led, User-owned ICT4Ag Enabled Information Service (MUIIS) based in Uganda is an extension service provided to farmers that includes data, knowledge, and advice to help farmers make effective decisions. Through the platform, farmers have access to assistance, as well as advice on crop insurance. This platform incorporates several partnerships from both the public and private

sectors, and includes LEAF Competence Center (eLEAF), EARS Earth Environment Monitoring (EARS-E2M), aWhere Inc., the Technical Centre for Agricultural and Rural Cooperation (CTA), the Alliance for a Green Revolution in Africa (AGRA), the East African Farmers' Federation (EAFF), and Mercy Corps Uganda. The project is funded by the Dutch Ministry of Foreign Affairs (MFA) through the Geodata for Agriculture and Water Facility (G4AW) of the Netherlands Space Office (NSO). MUIIS further empowers the farmer because the ICT product is owned and marketed by farmers. It is targeted at 350,000 farmers across Uganda, 35 percent of them women. Although the project is in early stages, MUIIS hopes to see a crop yield increase of 25 percent, and farmer incomes increase by 20 percent (CTA, 2016).

Connecting rural community libraries to the internet (Uganda). The Connect Uganda Pilot Project supplied each of five rural libraries with three netbooks and internet connectivity. Seven hundred farmers were trained to use ICT to search the web, where they could find available open data and information to learn about new species of plant, for example, or sources of tools. In the three libraries that lacked electricity, the project installed solar panels, which also allowed them to hold meetings and support internet access at night. The project partnered with the Uganda Community Libraries Association, a center for lifelong learning, and government farm support agencies. Ten volunteers were trained to organize monthly information meetings and to help non-literate farmers. When farmers learned about a disease-resistant coffee plant, librarians helped the farmers petition a government agency for seedlings. Librarians translated information from national farming agencies into local languages. They helped farmers start a blog and portal to market their products (EIFL-PLIP, 2014c).

Helping farmers improve plant health (worldwide). Farmers need information about plant pests and plant diseases, often in response to infestation or other urgent problems. Plantwise, a program led by the Center for Agriculture and Biosciences International (CABI) in the U.K., aims at helping farmers achieve higher yields through combating plant health problems. In partnership with national agricultural advisory services, Plantwise has established a network of more than 1,800 plant clinics that are run by more than 5,000 trained plant doctors in 34 countries. Clinics often take the form of information tables and poster boards that can be moved easily between town squares, village markets, and locations in the countryside. Farmers approach the tables with samples of their sick or diseased crops. Plant doctors use tablet computers and internet connections to access the Plantwise Knowledge Bank, an on- and offline open access resource for plant health information providing science-based research, with accurate and helpful recommendations for treating the conditions. Plant doctors' recommendations are continuously monitored through the Plantwise Online Management System to ensure that information passed down to farmers is correct and up-to-date. They can often supply farmers with printed information sheets. Users can find diagnostic resources, new research results, pest alerts, best-practice pest management advice, and plant clinic data analysis for targeted crop protection. With 200 partner organizations worldwide, it has been estimated that 4.5 million farmers have been helped (CABI Plantwise, 2017).

Bringing information to farmers in remote areas (Chile). Farmers in remote mountain villages of southern Chile have limited access to information about modern farming methods. A van equipped with a computer lab for teaching ICT skills can reach isolated farming communities and allow farmers to interact with experts on local radio stations. The ICT training, attended primarily by women farmers, covers internet search, use of an existing social network platform where farmers exchange experience and news, and use of an online market where farmers advertise their produce. The van also offers ICT training, which was developed with the help of youth interested in ICT and is offered to the broader community at its main location in town. A special area is dedicated to farming, with relevant literature and a room for meetings and presentations on farming methods. The facility has increased its collection of farming materials with help from agricultural organizations and the Ministry of Agriculture. Other partners include the Inter-American Institute for Cooperation on Agriculture (IICA), which supplies ready-made programs on farming; the municipal government; a regional development agency; and a university that is developing a text messaging service for farmers (EIFL-PLIP, 2014b).

Producing and screening videos on farming practices (Asia and Africa). Even if agricultural information and data is available openly, dissemination of information can be difficult in rural areas. Digital Green helps provide open data to farmers in a usable and culturally appropriate way. The organization has developed a participatory approach using open national sample survey data to study the effectiveness of knowledge sharing among peers. Using this information, Digital Green has worked with local women to develop videos that provide information on field operations, improved agricultural practices, and performance targets. One million farmers in more than 12,000 villages in nine states in India have watched these videos on mini-projectors that are brought to the villages. Four thousand videos in have been produced in 28 languages. Data is gathered about the dissemination of the videos, as well as adoption of the procedures described in the videos, and community interest is gauged to further tailor the videos to the appropriate audience (GODAN, 2017).

Helping rice farmers with low-tech cardboard information wheels (Thailand). Although the above examples show situations where it is possible for computers and the internet to reach farmers, sometimes this is impossible. In these situations, there must be alternative ways to provide a farmer with information and the benefits of open data. In Thailand, there are large amounts of data for Thai agricultural researchers

or companies that have access to computers, but there is no way for the least-resourced farmers to benefit from this data. To present information in an accessible way, the Hia Chai Rice Seed Center has designed a cardboard rice wheel. The wheel helps farmers to know when to grow their rice and when to harvest, based on the weather and the variety of rice grown. Due to the rice wheel, yields of rice increased by 10 percent (GODAN, 2016).

A2I doesn't need to be high-tech – the Hia Chai Rice Seed Centre in Thailand uses information wheels made of cardboard to make information about when to sow and harvest accessible. The project has led to yield increases of 10%.

3.2.3 A2I for rural data management

ICT training for women farmers (Uganda). In the Nakaseke district of Uganda, women farmers only speak the local language and do not have the ability to record their own data that could potentially be used to assist decision-making both at the local and government level. In 2012, the National Library of Uganda started the Electronic Information Empowering Women Farmers service in a central village of the farming district. A $15,000 grant from EIFL-PLIP paid for computers and mobile phones. An ICT training course was developed, including a manual in the local language. Sixty women attended the regular computer classes, which were held at the end of the working day in a local school. The training course, developed by NLU in the local language, covered internet search, email, Facebook, and record-keeping in Excel. The project also developed a text messaging service, training two youth volunteers with an interest in ICT to broadcast regular alerts about prices and weather. Partners in the project included the National Library of Uganda, a local school, and a community telecentre. In response to demand, the project organized ICT refresher courses and expanded its program to include men (EIFL-PLIP, 2014d).

3.2.4 A2I for market information

Electronic commodity exchange for farmers (Ethiopia). Receiving correct market information is necessary for knowing the best prices for a product. In 2008, in Ethiopia, farmers only received 35 to 38 percent of full export price. The Ethiopian Commodity Exchange Network (ECX) is an electronic commodity exchange for farmers that, through open data, gives open access to the price of crops and ensures the seller gets the correct price on a given day. Increased knowledge reduced the trader margins by half, with the farmers receiving increased revenue. This network has increased incomes for growers, and has reduced middlemen and commission charges. Market actors access real-time pricing for commodities, and information is accessed through SMS, telephone, electronic displays, the ECX website, TV, radio, and newspapers in four languages. The ECX includes warehouse management and quality certification, and guarantees payment against delivery. In 2012, 70 percent of the 1.2 million users were rural (GODAN, 2016).

Helping farmers reach new markets (Serbia). Farmers in central Serbia lacked the computer skills and network connectivity needed to access information and market their products. After years of war in the 1990s, followed by economic recession, four village libraries that existed in name only, gathering dust, reinvented themselves as information centers through the AgroLib-Ja project. In 2010, the libraries purchased computers with a grant from EIFL-PLIP and offered free internet access. As the project wrote, "Through AgroLib, we wished to overcome the traditional idea that libraries are places where you work with books." The library provided ICT training both for farmers and for the librarians themselves. It developed a website for the AgroLib project and a portal where local products could be advertised. Users of the product portal received their own business cards, with the AgroLib logo, which had the effect of advertising AgroLib at agricultural fairs around Serbia and abroad. Videos about project activities were posted to YouTube. The library also acquired up-to-date agricultural literature and hosted presentations by ministry officials about relevant regulations and available subsidies. When events were covered by local television stations, farmers enjoyed appearing in the news. In villages with few other venues for socializing, libraries also attracted young people. At project end, AgroLib received a further grant from the Ministry of Culture to extend its activities (EIFL-PLIP, 2014a).

43% of the agricultural labour force in developing countries are **women**.

3.2.5 A2I for nutrition

Teaching rural teenagers about good nutrition (Uganda). Teenagers in rural Uganda need basic schooling in good nutrition habits and sexual health. In 2014, the Uganda Community Libraries Association worked through five community libraries to institute Youth Leadership Groups, which held weeklong training camps on health, reading, and ICT skills [UgCLA]. The

camps included training in basic internet search and critical assessment of open data and information on personal hygiene, diet, and nutritionally sound farming. Vegetable gardens and fish ponds were created to exemplify nutritional principles. The youth leadership groups and camps made the libraries known in their communities as providers of informal education, and the libraries advised 30 other libraries eager to learn from their experience (EIFL-PLIP, 2015).

3.3 SDG2 subgoals and access to information

Sustainable Development Goal 2 will be achieved by the fulfillment of the subgoals, outlined below (UN, 2015). Thus, it is pertinent to ensure that the examples elaborated on above specifically answer to the subgoals. Please note 2.b and 2.5 are not included.

2.1. Ensuring access to food. By 2030 end hunger and ensure access by all people, in particular the poor and people in vulnerable situations including infants, to safe, nutritious and sufficient food all year round. Many of the farmers described in the examples benefit by increased access to information in two ways: 1) They grow more products and can feed themselves; and 2) they can sell more products, receive a higher income due to increased access to market information, and can buy more food for themselves and their families.

2.2. Ending malnutrition. By 2030 end all forms of malnutrition, including achieving by 2025 the internationally agreed targets on stunting and wasting in children under five years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women, and older persons. In addition to not having enough food, many farmers do not have the correct type of food to ensure adequate nutrition. By growing more diverse crops and having the capacity to plan for their planting and harvesting, while also protecting against pests, farmers and their families will be able to benefit from more nutritional diets. Additionally, with access to better market opportunities and fewer middlemen, products will reach the consumer in less time, reducing nutrient degradation.

2.3. Doubling the productivity of small-scale producers. By 2030 double the agricultural productivity and the incomes of small-scale food producers, particularly women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets, and opportunities for value addition and non-farm employment. Through open data and open access to information, incomes of small-scale farmers will increase due to early warning systems, advice on when to grow crops and harvest, and improved access to market opportunities. The above examples show the empowerment of women through increased ICT skills and the ability to register land. Videos and libraries, which host important and useful information, increase knowledge sharing and propagation.

2.4. Ensuring sustainable food production. By 2030 ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters, and that progressively improve land and soil quality. All of these examples seek to improve the food production systems and increase agriculture resilience especially in the face of climate change. These examples focus on farmer livelihoods as well as environmental sustainability and ecosystem protection. Satellite data, which can help farmers predict climate behavior and adapt for the future, is one of the primary sources of open data. Several of these examples help farmers receive more information on pesticides and fertilizers, making them better able to preserve soil health.

2.a. Investing in productive capacity. Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development, and plant and livestock gene banks to enhance agricultural productive capacity in developing countries, in particular in least developed countries. Most of these projects have been internationally funded, which demonstrates international cooperation in infrastructure, research, technology and gene banks. All of these projects are occurring in less developed countries.

2.c. Support food commodity markets. Adopt measures to ensure the proper functioning of food commodity markets and their derivatives, and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility. Several examples discuss how open data and open access to information improves farmers' access to market information. It is unlikely that this subgoal will be achieved without open data and knowledge sharing through the appropriate mediums.

Conclusion

Access to information and open data is key to achieving Sustainable Development Goal 2 and its subgoals. In the face of unique obstacles to equal access for smallholder farmers, the availability of the internet in rural areas can narrow the gap, though access to information and open data alone does not suffice if sociocultural issues and farmer needs are not sufficiently addressed. Nor does achieving SDG2 rely entirely on improving access to information for farmers. Farmers can themselves provide valuable data to researchers, industry, policymakers, and NGOs, raising complex issues of data ownership, privacy, and security. The Global Open Data for Agriculture and Nutrition (GODAN) initiative envisions a global data ecosystem, produced and used by a diverse set of stakeholders, that would address these challenges

of a global shared data and information space. Such an ecosystem would benefit and include everyone involved in the food system.

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