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A Data Commons for Food Security

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Abstract

We propose a 'data commons', formed through a licensing model that allows farmers to benefit from the datasets to which they contribute. Agricultural data is globally recognized for its importance in addressing food insecurity. This data is generated and used by a value chain of contributors, collectors, and consumers. Our licensing model addresses the crisis caused by a lack of data ownership rights for contributor farmers. Using the IAD framework we consider five case studies. These studies explore how John Deere, Plantwise, and Abalobi license data collection and how Creative Commons and the Open Data Commons license data distribution. Supported by an independent organization, our license supports SME data collectors, who need sophisticated legal tools; contributors, who need engagement, privacy, control, and benefit sharing; and consumers who need open access. Market forces encourage participation in the data commons by granting users the ability to display a social certification mark.

Keywords

open data, commons, licensing, data collection, creative commons, copyright, agriculture, social certification, certification marks, Institutional Analysis and Development

Executive Summary

Agricultural and nutritional data is an increasingly vital resource in the advancement and innovation of farmer organizations, food production, value chain development, and provision of services (Jellema, Meijninger, and Addison, 2015). Modern farmers rely on computational and precision agriculture to inform decisions. Datasets such as weather data, market price data, and agricultural inputs fuel these tools, which range from simple graphs to emerging artificial intelligence networks (GODAN, 2015). Access to and use of such data can play a key role in addressing global food insecurity by "enabling better decision making, transparency and innovation" (Open Data Charter, 2016). With this growing recognition however, is the understanding that ownership rights remain a major factor in the access to and use of data, distinct from yet, as important, as the availability of education, skills, technology, infrastructure, and finances (de Beer, 2016).

The importance of data for agriculture underscores a growing view that data has replaced oil as the world's most valuable resource (e.g. The Economist, 2017). For example, artificial intelligence relies on extremely large datasets to teach algorithms how to solve complex problems. As a global resource, the data commons proposed in this paper applies beyond agriculture to any data infrastructure. However, agriculture is a fitting locus for a data commons as the birthplace of the commons and as the site of other social certification programs such as the Fair Trade movement.

The field of agriculture also highlights an important geopolitical dynamic with data. In complex global markets, access to data can create situations of unequal power for those most vulnerable (e.g. Ferris and Rahman, 2016: 2; Davies, 2015). Current paradigms of data ownership and property rights reinforce these inequalities in ways that threaten sustainable development and food security. Most legal rights to data are owned by intermediaries that invest in the collection of data, arrangement of databases, safeguarding of confidential information, or similar activities. The lack of enforceable data rights owned by certain communities, particularly smallholder farmers, is an important ethical issue that contributes to inequality and marginalization.

The current contract-based model for access to open data leaves many stakeholders vulnerable to the whims of entities that own data, without addressing more systemic challenges and opportunities for open data governance. Meanwhile, expanding ownership rights to protect individual or community data contributors could cause significant complications for the intermediaries that practice and promote open data. There needs to be a shift towards encouraging the growth of innovative, sustainable and equitable platforms that allow for all players involved to receive benefits (Frischmann, Madison, and Strandburg, 2014: 11).

The 'data commons' offers a way to provide more equitable data rights for vulnerable communities and individuals, including small-holder farmers. This approach to agricultural and nutritional data stems from the "knowledge commons" a sharing model in which knowledge and information resources are shared to produce creative and innovative

products (Frischmann, et al., 2014: 5). It builds on the "growing realization that legal facilitation of innovation and creative production cannot be confined to a simple set of property rules to incentivize individuals to innovate" (Frischmann, et al., 2014: 11).

This paper uses the Institutional Analysis and Development ("IAD") framework to develop and understand the 'data commons'. As identified by Fischmann et al., (2014), this paper also embraces the analogy between the natural environment and the commons and uses this link as a lens to view the establishment of a data commons that seeks to address global challenges of food insecurity.

Instead of expanding or contracting ownership rights, the commons evokes the need for mutual responsibility towards data as a shared resource. A data commons views the actors who provide, collect, clean, interpret, and use data as stakeholders. As in a physical commons, a stakeholder approach acknowledges that actors are involved in inputs and outputs. Farmers contribute, governments, intermediaries and firms collect, and consumers develop new insights. Each input is necessary to produce useable data.

Legal and institutional mechanisms are needed to enable a data commons. These mechanisms would recognize the contributions of all stakeholders and distribute rights in ways that reinforce participation in the commons. Our proposal builds on the Open Data movement by looking to the legal and institutional processes used by Fair Trade movements to create successful commons.

The paper is structured as follows. Part 1 applies the IAD framework to computational agriculture, noting that legal and policy discussions often overlook the role of data contributors. Part 2 builds on the IAD analysis by considering the problems that arise when contributors' needs are overlooked. Part 3 considers the legal relationships between contributors, collectors, and consumers of data, often built through contractual licenses. We explore specific examples from three leaders in computational agriculture: John Deere, Plantwise, and Abalobi; and from two leaders in Open Data licensing: Creative Commons and the Open Data Commons. Part 4 explores building a back-to-front model license that can meet the needs of all stakeholders in the data commons. Part 5 looks to the Fair Trade movement for insight in growing traction for a data commons through social certification. Finally, Part 6 considers reasons for optimism, touching on how our framework and model license can apply beyond agriculture to other domains.

Part 1: Introducing the 'Data Commons'

The IAD model, developed by Elinor Ostrom (1990) and modified by Frischmann, et al. (2014), provides a theoretical framework to understand and challenge systems of data governance. Currently, collectors gather data by providing services or making investments in collection equipment. The defining characteristic of the data commons is a governance structure where all participants share responsibility for and engage equitably in the production of data (Frischmann, et al., 2014: 20). The modified IAD model captures the complexities that would arise and need to be considered in establishing a knowledge commons, including:

- Background of the resource;
- Characteristics of the pooled resource and the technologies and skills needed to create, obtain and maintain the resource;
- Members and their roles;
- Governance mechanisms, such as intellectual property rights; and
- The benefits and costs of participating in the knowledge commons.

The rest of Part 1 explores the first four aspects of the IAD model. The last aspect, the benefits and costs of participating is considered in Part 2: Bringing Contributors into the Commons.

A short background

The modern story of data begins in 1989 when Tim Berners-Lee proposed a world wide web of data. By 1997, the same year Google Search debuted, Michael Lesk estimated that as much as 12,000 petabytes of data existed worldwide. Ten years later, Web 2.0 created a market for data as companies like Facebook built business models on user created content (O'Reilly, 2007). Most recently, artificial intelligence and the internet of things have emerged as disruptive technologies (Ashton, 2009; Jordan and Mitchell, 2015). These technologies rely on extremely large sets of linked data. As a result, there is a global effort to represent as much of the world as possible through data.

As the market for data grows, there are increased concerns of privacy and exposure. Tim Burners-Lee (2017) recently warned that data-for-service models are vulnerable to a loss of trust among users, who are starting to seek control over their data. Although large data-driven companies have insulated themselves by making their services invaluable, small and medium sized enterprises (SMEs) stand to suffer as data sharing norms change.

Recognizing the value and importance of access to data, the open data movement formed out of the open access and open science movements (de Beer, 2017). Open data is data that anyone can access, use or share (The Open Data Handbook, 2016). By making data publically available and accessible, open data fosters innovation, enables more efficient decision making, and facilitates creative use of information. In turn, such use can generate new forms of public value by improving policy-making that can be used to address some of

the pressing challenges facing our global community, such as growing food insecurity. In particular, a data commons maintained by accessible and usable open data will foster transparency and collaboration among players which can foster new discoveries to help sustainably address the problems of feeding a growing population (Carolan, et al., 2015). For example, open data can be used to identify and develop solutions to underlying problems including pest infection or drought. Ultimately, the benefits of open data are well understood, with the firm, McKinsey & Co. (2013), valuing the global economic potential of open data at $3 trillion a year.

Characteristics: A structured analysis of data

The nature of data can vary. It is shaped by cultural and institutional norms, and can take many forms including 'big data', such as real time or consensus data, or more qualitative data including satellite images, pictures, texts or maps. However, data is generally technological in nature. It is created through the application of technique to capture and represent characteristics of a phenomena (De Mauro, Greco, Grimaldi, 2016: 123–125). The term "data" is often used to refer to both discrete information about a phenomena and sets of information compiled in databases. As a resource, data is characterized by the intersection of depletable phenomena and renewable knowledge. The events being captured and the methods of capturing data are tangible and limited. But once data is captured in a digital format it becomes an intangible resource and easily copied.

Data is created by persuading contributors, including for example communities and small-holder farmers, to provide access to the desired phenomena (de Beer, 2016: 11). Organizations then invest in the collecting, selecting, and aggregating the data, thereby creating distinct legal rights in newly formed data sets. In this process, contributors lack enforceable data rights, which adds to inequality and marginalization (de Beer, 2016: 14). In turn, this can lead contributors to be vulnerable to the whims of collectors that own the data. In order for data to yield benefits for these groups, there must be a reconfiguration of the data governance structure that allows for more efficient and equitable appropriation and access to data.

In a data commons, the characteristics of the pooled resources focus on the collection of agricultural data. Agricultural data is collected through a range of technologies and occurs at every point in the harvesting cycle from both modern, commercial operations and small-holder, sustenance farms (e.g. Carbonell, 2016; Jellema et al, 2015). Sensors in "smart" tractors record GPS, soil, and harvest data. Drones and satellites record land use and productivity data. Weather stations provide meteorology data. Markets generate crop yield data. In developing countries, data collection is often more labour intensive. Intermediary data collection agencies, such as Plantwise are often involved in reaching smallholder farmers. Other projects are developing mobile apps that allow smallholder farmers and fishers to track their own data and contribute to larger data pools. Using these technologies to capture data requires investment from a variety of stakeholders. This social dynamic highlights that "effective data sharing depends on a strong network of trust between data providers and consumers" (Allemang and Teegarden, 2016: 11).

The members: Contributors, collectors, consumers

Three categories of stakeholders participate in the community of data production and use; they are the key members in the data commons (Manovich, 2012: 460). Contributors provide access to the phenomenon being captured. They are often farmers, landholders, and front-line workers. Collectors gather data and make it available. Typically comprised of firms, intermediaries, and governments, collectors are the legal owners of the data and are responsible for opening access through licensing (de Beer, 2016: 14). Consumers use data to gain insights, develop applications, and make decisions. In the commons, contributors often consume data or benefit from the work of consumers.

Of these stakeholders, the open data literature primarily focuses on the relationship between collectors and consumers.[1] A data commons approach, however, requires engaging all stakeholders. Recent attention to data ownership highlights ethical concerns with the "misappropriation of data" by data collectors (de Beer, 2016: 21). Through their use of technology and application of intellectual property law, collectors hold proprietary ownership rights to data. Even when collectors offer open access, their ownership rights allow them to choose to publish partial datasets. In this scenario, contributors are not able to fully share in the benefits of the data they provide.

Governance: Intellectual property rights

The current governance structure of the open data commons is based on proprietary control over data. Ownership in data is a legal issue, based in intellectual property law.

Intellectual property rights ("IPR"), set out in domestic law and international treaties lay a framework that governs the use and collection of data. Members use the IPR framework to form agreements about how data can be used. A number of, often overlapping, legal mechanisms contribute to the bundle of property rights in data (de Beer, 2016: 8). Possibly, the most important of these rights for licensing data is copyright. However, a data commons must account for other rights in data including *sui generis* database rights, personal privacy, and protection of confidential information.

Copyright protects the original expression of ideas. Applied to data, copyright can exist in original compilations of data, such as databases. The protection extends to the structure of the database and specific combination of data chosen. TRIPS guarantees this protection across the 164 countries within the WTO. The standard for granting copyright in a compilation varies from country to country, but most require some level of creative input. Within the data commons, copyright favors collectors as the member from which the database originates. Although the data within a compilation, broadly described, may

[1] For example, Tim Davies (2010) refers to data providers as the "supply" of open data, although the data often originates from interactions between contributors and data providers.

include copyrightable works (e.g., a database of music), most agricultural data falls in the category of facts or ideas, which do not enjoy protection.

The European Union and Mexico offer *sui genres,* i.e. unique, rights in databases that are not otherwise copyrightable. European "manufacturers" that make "substantial investments in either the obtaining, verification or presentation of the contents" enjoy a 15 year right to prohibit the reuse or extraction of substantial parts of the contents of the database (Directive 96/9/EC of the European Parliament, 1996). Mexican law similarly provides a 5-year protection for non-original databases. These unique database rights have not gained the international traction hoped for by policy makers. In its 10-year review, the EU noted that "the new instrument has had no proven impact on the production of databases" (Commission of the European Communities, 2005).

Although privacy rights are not the same as property rights, they provide stronger protections for contributors (e.g. Warren and Brandeis, 1890; Samuelson, 2000; Lessig, 2002). Privacy rights allow contributors to control how their personally revealing data is used. The principle of informed consent guides privacy law. Contributors must consent before collectors can gather and use identifying information. Consent often occurs when contributors license other rights to data or in exchange for a service. However, there are no international instruments governing privacy rights and laws vary greatly between jurisdictions. Privacy is a necessary part of a data commons, but privacy rights alone are not sufficient to include contributors in a data commons.

Protection of confidential information, i.e. trade secrets, offers some of the strongest control over data. Regardless of ownership rights in data, collectors are under no obligation to provide access to their data. Instead, databases within the control of collectors can be kept confidential, with legal consequences should the data be released. The TRIPS agreement provides that "Natural and legal persons shall have the possibility of preventing information lawfully within their control from being disclosed to, acquired by, or used by others without their consent in a manner contrary to honest commercial practices".

Finally, data is usually collected and opened using licensing contracts. Creative commons and other standard open data licenses are available for collectors to license copyright in data and to license copyright and *sui generis* rights in databases to consumers. But these standard licenses do not consider the role and needs of contributors. It is important to note that licensing contracts transfer rights, but do not create new rights (de Beer, 2016: 11). For example, a license cannot create ownership rights for contributor data where copyright in the data does not exist. However, contracts can create enforceable norms between parties that achieve similar goals as ownership and meet the needs of contributors.

Part 2: Bringing Contributors into The Commons

Contributors are an essential part of the data commons. Farmer and fisher contributors have to participate in order for collectors to access data. Relationships between collectors and contributors can take many forms, but are usually based in IPR and formalized in contracts. The IAD model highlights how current data governance structures reinforce inequality by focusing responsibilities and risks of collection on contributors without sharing benefits.

With the view of data as a potential commons resource, this section begins by exploring how ignoring contributors leads to inefficiencies in the pool of data. Data collection is often authorized using contracts of adhesion that require contributors to agree to broad terms and conditions that allow many forms of data collection. But simply obtaining consent may not meet the needs of contributors and can lead to a lack of trust between contributors and collectors. This section considers these inefficiencies and then discusses three contributor needs that a data commons governance framework must address: engagement, privacy and control, benefit-sharing, and access to data.

Ignoring contributors is inefficient

Failing to meet contributors' needs is inefficient because it can lead to alienation, an erosion of trust, and a loss of access to data. In order to access data, collectors must build relationships with data contributors. But these relationships are formed within power divides that place farmers at a disadvantage. Isabelle Carbonell (2016: 2, 6) describes how this power divide creates risks for farmers and results in coercive data collection tactics. As farmers understand these risks they may withdraw from data collection or seek open-access options that meet their needs.

The relationship between contributors and collectors is often asymmetric, and even more so for smallholder farmers in the global south. This "big data divide" occurs as collectors have the technical expertise, storage and processing facilities, and legal sophistication to obtain and use the data (Andrejevic, 2014: 1674). A survey conducted by the American Farm Bureau Federation (2014) highlights some of the concerns farmers have with data collection. "Fully 77.5 percent of farmers surveyed said they feared regulators and other government officials might gain access to their private information without their knowledge or permission. Nearly 76 percent of respondents said they were concerned others could use their information for commodity market speculation without their consent".

Data ownership remains a concern for farmers. Farmers believe they own their data despite the legal reality highlighted by de Beer (2016: 14) that collectors, not contributors, own agricultural data. The American Farm Bureau Federation survey (2014) reported that "more than 81 percent believe they retain ownership of their farm data", yet more than 82

percent were unaware of how collectors intended to use their data. These concerns are also felt by smallholder farmers, who are often skeptical of large multinational corporations. For example, Abalobi report that they chose to give fishers ownership over data because of these concerns, and that they have seen greater engagement with their services because fishers feel that they can trust how their data is being used (Serge Raemaekers, personal interview, May 22, 2017).

Open data is seen as a way to build trust. For example, Syngenta (2015) has opened access to certain datasets in order to build trust in its Good Growth Plan (Hardinges et al., 2016: 17). Syngenta collects data from 3700 partner farms from 42 countries, with a focus on gathering data from smallholder farms in the global south. Although highly commendable, data ownership remains an issue. Syngenta publishes the data under a Creative Commons license and retains the ability to be selective in what it publishes or to stop hosting the data at any time. Highlighting these concerns, of the 42 countries included in the datasets, a majority are from the developing world where the competitive advantage of opening data outweighs possibilities for profiting from the data. Of note, large agriculture markets including the United States and Canada are not represented.

Proprietary business models that ignore the needs of contributors also suffer from selective use of data (Carbonell, 2016: 3). As collectors focus their efforts on products that can be monetized, products that provide data on externalities and vulnerabilities may hurt other parts of an agribusiness model and are ignored. Computational agriculture is often focused on industrial farming methods and the insights provided by agribusinesses are not tailored to the methods used by smallholder farmers. For example, Carbonell points to the role that big data could have played in understanding the effects of pesticides on bee colony collapse. By focusing on industrial agriculture, monoculture practices are enforced while small farm methods that may be more efficient are ignored (e.g. Pretty, Ball, Lang and Morison, 2005).

Meeting contributors' needs

A data commons that engages all stakeholders must address the specific concerns and needs of contributors. Although contributors may not own their data, their needs can still be met through the contracts that form relationships between peers. Together, these needs form a baseline that we will use in Part 3 to evaluate three examples of current data collection licenses. Although our focus is on the formal legal tools that meet these needs, substantive relationship building and technological development is also required to bring contributors into the commons.

It is important to note that these needs can, at times, be in conflict. For example, opening access to data may conflict with concerns for privacy. For this reason, we begin with engaging contributors throughout data production and use. Including contributors in decision making processes is key to balancing needs of privacy, benefit sharing, and access to data.

Contributors need engagement

Data collectors often rely on contracts of adhesion to license their activities. Contributors are required to agree to their terms if they want to participate in the relationship or service, on a "take-it-or-leave it" basis, without room for negotiation (Goodman, 1999: 319). Contracts of adhesion are common within consumer, and particularly technology and software development sectors because they create legal certainty and enable collectors to scale up the number of contracts they form. Given these realities, other mechanisms are needed to ensure that contributors' voices are heard and their needs are met.

Data contributors need to be engaged both in the creation of licenses and in the development of data collection and management technologies. In the agile world of technology, top-down processes may be tempting for collectors but meaningful engagement should also involve grassroots contributors from the bottom-up. The American Farm Bureau Federation, has done considerable lobbying on data privacy, including two surveys of its members (2014; 2016); building a consensus around Privacy and Security Principles (2014) among precision agriculture companies, including John Deere and Monsanto's Climate Corporation; founding the Agriculture Data Coalition (2017), a nonprofit data platform "based on data owner permission"; and the Ag Data Transparency Evaluator (2017), which evaluates and certifies companies' contracts across ten criteria of transparency, simplicity, and trust. Although admirable, these efforts are focused on American industrial agriculture. Collectors must also engage with the concerns of global contributors and smallholder farmers, who are more vulnerable and at greater disadvantage when dealing with sophisticated firms (Ferris and Rahman, 2016: 9).

Contributors need assurances of privacy and control

Privacy is widely recognized as a fundamental human right (e.g. The Universal Declaration of Human Rights, 1948: art 12). The rise of computational agriculture has created a number of privacy concerns for farmers. The highly detailed information created by precision technologies can be used to gain competitive advantages, manipulate markets, or make regulatory decisions that may not align with the contributor's interests. Because data lasts indefinitely, exposure to the risks of privacy breaches can compound over time. A majority of farmers in the American Farm Bureau Federation surveys (2014; 2016) echoed these concerns. Smallholder farmers and indigenous communities are especially vulnerable because data breaches may reveal valuable traditional knowledge to malicious actors (Farris and Rahman, 2016: 9).

The need for privacy extends beyond protection of data to the ability to know and control who has access to data, to retrieve and share data, and to delete data on request. These control mechanisms have been widely recognized as needed by agribusinesses, a number of which have agreed to implement the mechanisms in their contracts with farmers (Privacy and Security Principles, 2014). These principles of privacy and control also form the basis of analysis by the Ag Data Transparency Evaluator (2017).

There are valid concerns that contributors, particularly in developing countries, may not understand privacy implications. But, Abalobi's experience with fisherfolk, suggests that smallholder food producers are concerned with data ownership. CEO Serge Raemakers (personal interview, May 22, 2017) attributes high user satisfaction with Abalobi and retention to their data privacy policies.

Contributors need benefit sharing

The IAD model includes costs and benefits of participating in the commons as part of its analysis. A healthy commons motivates collective action by distributing costs and benefits across its members (Ostrom, 1990: 39). Based in ideas of data ownership and equity, many contributors feel that they should receive the benefits generated from their data. Although legal mechanisms are not available to ensure benefit sharing, it is an understandable need given that agricultural data has value for collectors and presents risks to contributors. The American Farm Bureau Federation survey (2016) reports that "66 percent of farmers said it was extremely important or important that they share in potential financial benefits of their data".

Startups are building services around the need for benefit sharing of data. Kansas based Farmobile (2017a) allows farmers to collect their own data for sale in a "Data Store" marketplace. The store allows farmers to sell single-use licenses to third parties. Their terms and conditions make compensation mechanisms and requirements clear, including the rate for data of $2USD per acre (Farmobile, 2017b: 1). However, their marketplace is limited to 500 corn and soybean farmers in the United States and users must meet specific certification requirements.

Contributors need guarantees of access to data

Benefit sharing includes more than direct compensation. Potential benefits of agricultural data include new fields of research, greater efficiencies in supply chain management, and new applications and artificial intelligence products built on the data. Open data is key to delivering these benefits and to addressing the power imbalance between sophisticated collector companies and contributors (Carbonell, 2016: 7; Farris and Rahman, 2016: 11; Jellema, et al., 2015: 7). Clauses setting out the specifics of opening data should be included in collection licenses.

Many farmers and fishers already benefit from open data or shared data. Weather data, maps, and satellite imagery are open access tools used by many contributors. Data collected by Plantwise is empowering research on the scope and spread of plant based diseases (e.g. Hirschfeld, 2017). GODAN features open data success stories that highlight how open data is driving agricultural innovations (Compton, 2016; 2017). Examples include, SMART! an app that uses open data to make precise recommendations for using fertilizers, and eLEAF a service that uses open satellite data to help farmers in South Africa lower water consumption and increase fruit production in orchards. (Compton, 2016: 8, 14). Demonstrating these benefits to contributors can be a powerful motivator for data sharing

(Allemang and Teegarden, 2016: 7). In turn, agribusinesses that want to engage and build trust with contributors may be motivated to open their data.

Although opening data may appear to be in conflict with privacy, these concerns can be addressed by aggregating and anonymizing data, and by showing contributors the value of opening data. For example, Abalobi creates value in sharing data by using the data to create "social stories" about their catches that adds value on a fair trade market (Serge Raemaekers, personal interview, May 22, 2017). In aggregate over time this data can provide insight into fishery stocks and harvesting practices.

Respecting principles of privacy and control, collectors that plan to open data should obtain consent. The license should be clear on where to access the data, how it will be anonymized, and what standards are used to encode and store the data. To ensure benefit sharing, open data licenses should also create rights of access for contributors. Terms of access give contributors guarantees that the data will be available to use. These are important concerns because the collectors own the rights to data, which include the right to revoke access at any time. Access terms should be clear about how long the data will be available. If public access is given for a time-limited period, the terms should be clear about contributors' rights to use the data after access is withdrawn. Data licensing is based in copyright law so terms governing access to open data convey a copyright license to contributors.

Part 3: Licensing Agricultural Data

In Part 2, we described how contractual relationships are important for gathering and distributing data and are an essential governance mechanism to bring contributors into the data commons. This section explores in depth the use of contractual licenses as a governance mechanism to address the needs of contributors. Licenses for data collection are distinct from open data licenses for distribution. There are practical reasons why these licenses are kept separate. The parties to the licenses are different; collection licenses are formed between contributors and collectors while distribution licenses are formed between collectors and consumers. The subject of the licenses are also different; contracts for collection license privacy, control, and transparency while distribution contracts license rights in copyright. For these reasons, in Part 3 we consider collection and distribution licenses separately.

Licensing data collection

Agriculture data collectors are represented by a broad variety of actors, including governments, large commercial enterprises, smaller social enterprises, and NGOs (Allemang and Teegarden, 2016: 6). Different types of actors are characterized by differing business models, legal sophistication, methods and access to data, and relationships with contributors and users. We have chosen to profile three types of stakeholders that collect data: John Deere, a large agribusiness; Plantwise, an NGO that works with smallholder farmers; and Abalobi, a social enterprise developing catch solutions for fishers. Following the IAD model, each organization is characterized by different backgrounds, types of data collected, membership roles, data governance mechanisms, and costs and benefits for participating.

John Deere, a data agribusiness

John Deere (2017) primarily collects data through sensors installed on farm machinery or stations deployed in fields. These sensors wirelessly collect a range of information, including machine operations, environmental and soil conditions, and crop yield and nutrient data. John Deere processes this data and provides it to farmers in several digestible formats through its APEX software. Farmers can share this information with dealers and specialists that use the data to prescribe solutions to problems and suggest ways to increase efficiency. John Deere sells hardware through its dealership network and its software offerings are available for purchase online. Subscription to the JDLink network is necessary to move data between sensors and analysis tools.

Contributors agree to John Deere's *Data Services & Subscriptions Statement* (Appendix A) on accessing or using the products. The contract only applies to a limited number of countries, including the US, Canada, Australia, and South Africa. Contracts that apply to other countries have lower data and privacy protections (e.g. John Deere, 2014). As a sophisticated contract of adhesion, the statement is clear that use allows John Deere to

collect and use contributor data. Ownership and control of data are emphasized. The first line of the agreement states "YOU CONTROL YOUR DATA". It goes on to describe the types of data that John Deere may collect, what it means to control data, how John Deere can use the data, and the steps they take to safeguard the data.

Echoing John Deere's engagement with the Privacy and Security Principles (2014), the agreement provides clear rights of privacy and control. It authorizes collection of production data, machine data, and administrative data. John Deere uses this information to provide services, to develop and improve products, to market to consumers, and to comply with the law. Control over data is defined as the ability to share data with others, manage production data and some forms of machine and administrative data, to export production data, and to delete and amend data. Privacy is maintained through technical and procedural safeguards. Finally, the agreement is clear that individual contributor data is not shared or used for other purposes.

The agreement fails to provide benefit sharing or open access to data. Contributors agree their data can be included in anonymized datasets. They also agree that John Deere has proprietary ownership to this anonymized data. The agreement broadly authorizes use and disclosure of this data and allows the John Deere to "promote information and services derived from" the data. This clause allows John Deere to open access to contributor data if they chose to do so, but also allows use of data for commercial uses.

Plantwise, an NGO helping smallholder farmers

Plantwise (2017) is a global NGO founded by the Centre for Agricultural and Biosciences International (CABI). Their mission is to reduce crop loss by giving plant health advice to smallholder farmers. Working with 34 countries they have established 2,300 plant clinics and trained 6,800 plant doctors to diagnose and treat crops. These clinics generate important data about the prevalence of pests and crop diseases.

Data collection begins when farmers bring samples of their plants into clinics, often located in local marketplaces. Similar to human clinics, plant doctors examine the plants and prescribe a recommended treatment. During this process the plant doctor, who is usually a government extension worker, fills out a form describing the location, crop variety, presenting symptoms, and their recommendation (Willis Ochilo, personal interview, June 6, 2017). In 10 countries and 432 clinics, this data is completed digitally using tablets (Plantwise, 2016: 3). After the data is recorded, it is transferred to central processing facilities where it goes through a process of harmonization and validation to ensure data accuracy before being analyzed and stored in the Plantwise Online Management System.

Collected data is owned by the respective governments that partner with Plantwise. Each country has its own Online Management System and carefully restricts access. Pest and crop disease data has the potential to harm trade, so data privacy is strictly protected. Although plant doctors are not trained to discuss data collection with farmers, they are taught that the government owns the data, the importance of privacy, and what aspects of

the data they can access. Government agencies use this data to develop policy and respond to pest infestations. Farmers benefit from the data as it is used to fine tune recommendations and bolster the Plantwise Knowledge Bank and generate fact sheets. As a result, Plantwise (2016: 10) reports that 61 percent of clinic visitors in 2016 had an increased crop yield, 70 percent had increased crop-related income, and 97% of clinic users were willing to share clinic advice with non-users.

Plantwise is working with government and industry stakeholders to open the data in order to maximize its impact. Given the sensitive nature of the data, it may not be possible to meet classic definitions of open data. To ensure farmers can experience the practical benefits of linked data, Plantwise is engaging with stakeholders to develop measured solutions and encourage data sharing. Through this process, they emphasize the importance of engaging with stakeholders by creating an environment that allows all participants to air their concerns and contribute to the final product (Martin S. Macharia, personal interview, June 6 2017). Their experience points to the need for nuanced licenses that allow collectors to manage privacy concerns while sharing data.

Abalobi, a social enterprise for fishers

Abalobi (2017) is a non-profit social enterprise that provides South African fishers with a suite of apps to track, manage, and sell their catches. Their products help fishers build small businesses or form fisher cooperatives. Science, conservation, and planning agencies are very interested in accessing data on small-scale fisheries. The app system provides a way to connect science and local knowledge while respecting the rights of fishers who can be skeptical of institutions (Serge Raemaekers, personal interview, May 22, 2017).

Fishers co-designed the app and were involved at all stages in the development process to ensure the project met their needs. Abalobi continues to involve fishers in the governance process as their apps and services evolve. Their products were initially developed as a research project out of the University of Cape Town and funded through various grants. The apps are published open source, allowing other small-scale fisheries to build on their platform. Fishers start using Abalobi by installing the “Register” app. On registering they are asked to agree to Terms of Use (Appendix B) that details access and use of contributor data. Once registered, the fisher receives access to the other apps including the “Fisher” app to log catches, and track economic and oceanic parameters to access weather condition data that can help farmers stay safe at sea. The “Monitor”, “Manager”, and “Co-op” apps allows fishers and cooperative to track and manage their catches and do accounting and business planning.

Their engagement process made clear from the beginning the importance of data ownership to fishers. As a result, Abalobi used data ownership as a design principle that is showcased in the the app (Serge Raemaekers, personal interview, May 22, 2017). The Terms of Use promise to treat contributor data “with the utmost of privacy”. Individual fisher data is not shared with third parties without consent. The Terms of Use also detail who can access and use the data. Contributors agree that Abalobi staff may access data to

maintain and improve the system, but would have to obtain permission to use the data in research papers (Serge Raemaekers, personal interview, May 22, 2017). Contributors can also optionally agree to share their data with local Fisher Assistants and with the Department of Agriculture, Forestry, and Fisheries. These agreements allow fishery planners to access data, but on terms provided by fishers. The Terms of Use also promise that fishers will always be able to access their data. Although not mentioned in the terms, this includes the ability to download the data in pdf format.

The services provided by the apps are an incidental benefit to data sharing. Because data sharing is optional and fishers are understood to own their own data, they are able to receive the benefits of using the app whether they agree to share their data or not.

Currently, Abalobi provides a closed data system and does not provide open access to fisher data. The Terms of Use does allow Abalobi to publish aggregate data (e.g. "Total kg Snoek catch recorded in South Africa in Nov 2016"). However, Abalobi does not interpret this clause as allowing them to publish open data without obtaining further permission. Data sharing is required if fishers want to use the market app. This app allows fishers to sell their catches globally on the fair trade market. To obtain a fair trade certification, fish are marked with QR codes that link to logged data about the catch. This data collects over time, moving the data to open access by showing fishers a value proposition that creates confidence in Abalobi and in data sharing.

Licensing data distribution

Licenses for data distribution can either be proprietary or open access. In both cases, the license forms a relationship between collectors and consumers of data, transferring rights based in copyright to access and use the data. As a data commons is based in governance mechanisms that enable access, this section focuses on two licenses commonly used to open access to data: Creative Commons for Data and the Open Data Licenses. Many of the features and lessons learned from the development of these licenses can be applied to the development of governance mechanisms, including a back-to-front license scheme and a supporting organization that includes contributors.

Creative Commons

Creative Commons (2017a) is an American non-profit organization that helps people legally publish their creative works. The organization was founded in 2001 by Lawrence Lessig, Hal Abelson, and Eric Eldred to let copyright owners reserve certain rights in their works while waiving rights they do not need. The first version was published in 2002. Since then, the license scheme has gone through four versions. Creative Commons licenses now work internationally and cover many different types of content, including data. More than 1.2 billions works have been published using Creative Commons licenses (Creative Commons, 2017b). Their success has demonstrated the value of an easily understood license as a social certification scheme created by a legally sophisticated and trusted organization. A

key part of their success comes from engaging with stakeholders at yearly summits held globally.

Creative Commons (2017c) offers six different licenses ranging from permissive to restrictive. These licenses are characterized by stackable rights. The most permissive license allows any use with attribution. Other licenses require downstream creators to publish derivatives openly through a share and share-alike clause, prevent derivatives, or prevent non-commercial uses. Each type of right is accompanied by a graphical mark, visually indicating the responsibilities associated with using the content.

Creative Commons (2017c) has developed a unique three-layer design that makes it easy to use and has contributed to its success. The licenses' legal language is supported by a human readable layer that is easy to understand and a machine readable layer that lets software (e.g. Google Image Search) understand what license has been applied. Creative Commons has developed a license wizard that makes it easy for owners choose a license.

Data can be openly licensed using version 4 of the Creative Commons license. The license has a broad application, covering rights in databases, and when applicable, in the data itself. The license covers rights held in both copyright and *sui generis* database rights when applicable. Agricultural organizations, including Syngenta (2015) use Creative Commons licenses to share their data.

Open Data License

The Open Data License and Public Domain License offer other options for collectors wishing to open their data. The licenses are hosted by the Open Data Commons (2017), a non-profit organization that was founded in 2008 by Jordan Hatcher to "provide legal solutions for open data." An Advisory Council made up of legal and subject matter experts manages and drafts the licenses. In addition to providing licenses and community norms, the Open Data Commons hosts resources for collectors seeking to open their data.

Collectors can choose between two open data licenses. Similar to Creative Commons, these licenses require consumers to attribute (BY) or attribute and apply similar licenses to derivatives (ODbL). Both licenses are currently on version 1. The licensing model includes both a human-readable summary as well as the legal license. Unlike Creative Commons, Open Data licenses do not grant rights to the data itself. The licenses only grant rights over the database as an original compilation under copyright, or the extraction and re-utilization under *sui generis* database rights. A graphical mark is not offered, instead the licenses are applied through a textual statement.

Part 4: Proposing a Model License

To create a data commons, legal instruments are necessary governance mechanisms that can help collectors manage their relationships with contributors and collectors. Following the success of the Creative Commons, we envision an organization supported by a community dedicated to building and managing the license scheme. This work could be done in an existing organization, like GODAN, the Creative Commons or the Open Data Commons, or by creating a new organization. Part 4 discusses the work that organization would have to do to develop these important mechanisms, including showing the value in building a back-to-front model license, determining the necessary characteristics of the license, and avoiding potential limitations in developing the license.

Building a back-to-front license

A back-to-front license represents two licenses covering the relationships in the data commons. The first license, for data collection, is between collectors and contributors. The second license, to open data, is between collectors and consumers. We use the term to represent how the two licenses can be linked to better meet the needs of all parties. The distribution license would seamlessly fulfil assurances of privacy, control, and openness made in the collection license.

A back-to-front license for agricultural data collection will help SMEs meet their legal obligations and address the ethical concerns of data contributors. Our overview shows a need among SMEs for sophisticated legal solutions that will help them license the use of their products and license data collection. The need for easily applied legal solutions for data collection is not only present in the agricultural community, but broadly needed across the data collection community. This presents an opportunity for the open data movement to establish a data commons by providing a set of licenses needed by collectors while assuring contributors their data will be openly available in aggregate.

The process required to build and maintain a back-to-front license provides an opportunity to engage all stakeholders, and especially contributors in the data collection process. While this work cannot replace collectors working directly with contributors, an external organization can help ensure that data collection licenses meet the needs of data contributors.

Characteristics of a back-to-front license

Our review suggests several important characteristics for a back-to-front license. First, the license should balance the needs of all stakeholders, with particular focus on contributors of data. Second, the license should be modular and flexible to meet different use cases. Finally, the license should be designed simply to maximize use.

First, the license should balance the needs of all stakeholders. While we have proposed a model license to address the needs of contributors, the needs of all stakeholders must be

considered and balanced to achieve a data commons. To help achieve the goal of food security, highest priority should be given to considerations of openness and privacy. Successfully balancing these concerns is essential to including all parties in the data commons. This balancing can occur by providing tools to help contributors engage with stakeholders about how to maintain privacy while opening data. Licenses that enable data sharing as well as open data will also help maintain this balance.

Second, the license should be modular. Creative Commons has shown the value in addressing a variety of use case scenarios by providing licenses on a sliding scale of restrictiveness. These licenses maximize adoption by letting creators choose which license best fits their needs. Similarly, a back-to-front license should give collectors options to meet a range of business models. Licenses can vary depending on what and how much data is opened, the opportunity for other benefit-sharing measures, and the degree of control over data.

Finally, the license should be designed to maximize use. Following best practices developed by Creative Commons, the license should consist of three layers. The legal code of the license should be supported by both a human readable layer and a machine readable layer. While the human readable layer is important for simplicity of use, the machine readable layer is particularly important to maximize use by app developers. The machine layer should come packaged with a code library that lets developers easily import the license into their projects. In addition to search and use tracking, a machine layer would allow the organization to display the license using a branded graphical interface that would show contributors the human readable license as they are asked to agree to the terms. In addition to the benefits of simplicity, over time the interface would become recognizable and trusted by contributors.

Limitations

The organization building the back-to-front license must address several limitations. Collectors may want more individual control over specific license terms than are possible with a model license. Adoption may be slow, as many collectors, which our model relies on, may be hesitant to open their data. Collectors that want to implement a data commons face the challenge of working with hosting and service providers that respect the commitments made in the license.

These limitations can be addressed by working to meet the needs of collectors. The license should be developed to cover areas where little will change between collectors while providing guidelines on how to interface with specific terms of use for a collector's needs. The open data movement has many resources focused on showing collectors the value of open data (e.g. Open Data Institute, 2017). Although we have focused on the relationship between contributors and collectors, licenses between service providers and collectors are similar. The organization developing the license could develop relationships with and list service providers that are committed to maintaining standards of openness, privacy, and control.

The organization could spearhead development of a technological solution to help collectors offer individualized licenses to contributors. Following Abalobi's example, contributors that wish to participate in open data or data sharing could receive licenses that are tailored to these choices, while contributors wishing to maintain greater levels of privacy may opt for a more restrictive license. The complexity of this solution is scalable with modern database technology.

Part 5: Building Traction

In order for a data commons to garner enough support there must be mechanisms in place to motivate engagement. Ostrom (1990: 185 – 187) describes how monitoring and graduated sanctions are necessary to ensure mutual participation. In the context of a knowledge commons, participants will often experience rewards and benefits that help motivate participation (Frischmann et al., 2014: 37). Certification marks are commonly used to encourage participation and ensure equitable benefit sharing and protection. Examples include the Fair Trade movement, the Fair Trade Music campaign, and forest management certificates like those issued by the Forest Stewardship Council.

Certification marks are trademarks that a certifying organization can issue to entities that meet qualifying standards. The marks tell customers that certified products comply with standards that they care about (Fromer, 2017: 127). In the data commons, a certification mark would indicate to contributors, collectors, and consumers: (1) that the data is sourced equitably; (2) that the collector offers open data; and (3) which collectors use the back-to-front license. Simply stated, the mark would be an indication on the best practices used throughout the value chain related to the data (de Beer, 2017: 21). Use of the mark will motivate collectors to participate in the commons by drawing positive attention to their data collection practices while building trust with contributors and consumers.

Lessons can be drawn from other social certification schemes, wherein certification marks have encouraged ethical consumerism (de Beer, 2017: 21). As explained below, this has been particularly successful where there is international cooperation supported by a formidable movement. A clear example is the Fair Trade movement, which uses certification marks as a way to support marginalized producers in low-income countries. It is a particularly fitting example for our proposal, given Fair Trade originated in agriculture production. The Fair Trade movement has been successfully used as a template, including being adapted to the music and forestry industries (Fair Trade Music International, 2017; Leonardi, Clement, and Defranceschi, 2012). The data commons would not have to re-invent the use of the marks for community licensing requirements, but rather could follow the same footsteps and be brought into an already established social certification “family”.

Fair Trade

The Fair Trade movement evolved out of the global response to offset the negative effects of and provide financial support to small-scale, low-income producers marginalized by globalization (Ogumanam and Dagne, 2014: 86). In the 1980s, concepts and shared norms of “fairness” in the production, trade, and selling of products began to shape and accelerate (Raynolds, Murray, and Wilkinson, 2007: 15). One of the first initiatives, involving Mexican coffee farmers working with a Dutch development agency Solidardid, showed that working closely with local producers in order to build a sustainable economy could also improve human rights and build society (Zografos, 2010: 150). In the following years, other fair trade organizations realized that using a Fair Trade mark to certify

products benefits producers and workers by providing guaranteed prices that are higher than the world market price.

Fair Trade marks rely on "independent third party standard setting and certification" (Zografos, 2010: 150). While the Fair Trade movement initially began with different initiatives using individualized fair trade marks, by the late 1990s one single logo was developed under the umbrella organization, the Fairtrade Labelling Organization International ("FLO"). Fair Trade has rapidly expanded in the production of agricultural products, particularly within the last two decades where it has "grown from an obscure *niche* market to a globally recognized phenomenon" (Raynolds, et al.,: 5, 33). A network of member-driven organizations work together to develop and enforce fair trade standards. These standards work to achieve key objectives including for example, that producers receive prices to cover costs of sustainable production, and ensure the conditions of production and trade of Fair Trade products meet specific social, economic, and environmental criteria (Fairtrade Labelling Organization International, 2017).

Fair Trade Music

As an effective certification scheme, the Fair Trade movement provides a template for establishing the data commons and conceptualizing an organization to support its development. For example, Fair Trade Music International (2017) ("FTMI") was founded as a response to the de-valuing of music by file-sharing. The organization uses a certification mark to recognize and promote "fair behavior" within the music production ecosystem. The certification scheme began with academic discussions of the need for changes to copyright markets in order to address inequities in the interests of creators, consumers, and the public (e.g. de Beer, 2017: 172; Lalonde, 2014). Between 2010 and 2014 the scheme gained institutional support from organizations representing music creators worldwide (Fair Trade Music International, 2017). A series of international meetings engaged music creators around values and objectives of Fair Trade Music. FTMI, was formed in 2015 as an independent organization to manage the certification scheme. Certified entities can display the Fair Trade Music mark, which FTMI claims increases likelihood of purchase by 15%, even when the music is more expensive.

Social certification schemes like Fair Trade and Fair Trade Music are successful because they leverage consumers' desire for ethical and fair behavior (de Beer, 2017: 174; Raynolds, 2000) Although there is some debate about consumers' willingness to pay for ethical consumption,[2] we have highlighted how collectors must navigate contributors' desire for ethical behavior as well as consumers desire for ethical consumption. We expect a premium on ethics and trust in a marketplace where contributors are free to choose to

[2] For example, a face-to-face survey of 284 people in US supermarkets by Loureiro and Lotade (2005) found that consumers were receptive to fair-trade and willing to pay higher prices. But a survey of 808 people in Belgium by De Pelsmacker, Driesen, and Rayp (2005) found that customers were only willing to pay a 10% premium for fair trade coffee.

whom they provide their data. In this way, a social certification scheme can rely on market forces to develop a back-to-front license that promotes equitable data collection and sharing.

Part 6: Growing Optimism

In this paper we propose a "data commons" through the creation of a model back-to-front license to address a growing crisis caused by the lack of data ownership rights for contributors of data. Supported by an independent organization, this model license has the potential to increase the pool of open data. Our proposed license provides incentives to open data while supporting SME data collectors, who need sophisticated legal tools, and contributors, who need engagement, privacy, control and benefit sharing. Market forces encourage participation in the data commons by granting users of the model license the ability to use a social certification mark.

These governance mechanisms will increase access to agriculture data by fostering shared responsibility to data as a common resource. Increased access to data addresses food insecurity by helping participants across the food production chain make better decisions. In addition to the pressing concern of food security and global effort to meet SDG 1 by eradicating extreme hunger, we chose to ground this paper in the field of agriculture and nutritional data for several reasons: (1) the equity concerns of agricultural contributors have been recognized by the open data and agricultural communities; (2) the availability of exemplar stakeholders, whose work has been amplified by organizations like GODAN and OD4D; (3) the social certification examples, like Fair Trade, that have pioneered market-driven equitable agriculture production; and (4) the origin of commons and commons scholarship in agriculture.

The data commons and governance mechanisms we advocate in this paper are broadly applicable to other contexts where contributors generate data and open access to data is valued. A back-to-front model license and social certification scheme is particularly useful in the growing contexts where private SMEs collect and use data. For example, in healthcare, the growth of fitness trackers and other wearables has led to markets for health data (e.g., Christovich, 2016). Although not a traditional area of focus for open data, there is potential for scientific research if aggregated data was available. Another example is the rise of innovative transportation apps like Google Maps, Waze, Uber, Lyft, and Citymapper. These apps generate large amounts of GPS and travel data that have the potential to greatly benefit municipal planners. Users of these technologies may receive immediate benefits in the form of free services, but the mechanisms described in this paper offer opportunities to motivate broader opening of data while meeting the needs of consumers.

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Appendix A: John Deere's Data Services & Subscriptions Statement

JOHN DEERE DATA SERVICES & SUBSCRIPTIONS STATEMENT

YOU CONTROL YOUR DATA

In an increasingly connected world, technology makes it easy for you to share your operation's data with others — if that's what you choose to do. When you entrust your data to John Deere and its subsidiaries through our Data Services and Subscriptions, we safeguard that data and honor the permissions you set for sharing it with others.

We created this statement to be clear about how we manage your data and to provide the details you need to make informed decisions about our Data Services and Subscriptions. This statement explains:

- your responsibilities for managing your data and sharing permissions, as well as your options in the event that you do not want John Deere to use or disclose your data
- the types of data we may collect from you
- how we may use or disclose that data
- our responsibilities for protecting and maintaining your data

By accessing or using any John Deere Data Services and Subscriptions, you agree that we may collect and process your personal information as described in our Privacy Policy, and you agree that we may use your data as described below and in the applicable terms of use. If you do not or cannot agree to these uses by John Deere, then you should not use John Deere Data Services and Subscriptions.

TYPES OF DATA WE COLLECT

We collect three kinds of data through the John Deere Data Services and Subscriptions, which include the John Deere Operations Center, JD Link™, and other offerings listed at www.JohnDeere.com/agreements

Production Data is information about the work you do with your equipment and the land where you do that work.
For example:

- field task details
- area worked
- route travelled
- crop harvested and yield data
- agronomic inputs applied

You can see and manage your Production Data in the John Deere Operations Center and mobile apps.
Machine Data is information that indicates machine health, efficiency, and function.

Machine Data comprises:

- machine health indicators, settings and readings
- machine hours or life
- machine location
- diagnostic codes
- software and firmware versions
- machine attachments, implements or headers

You can see some Machine Data in the John Deere Operations Center, JDLink Web and mobile apps. Some Machine Data is proprietary to John Deere.

Administrative Data is information that helps us support your account and activities in our system.
For example:

- your data sharing permissions
- users linked to your account
- machines, devices, and licenses linked to your account
- number of acres and size of files
- information about how you use your account

You can see and manage some Administrative Data in the John Deere Operations Center and mobile apps.

We do not use or collect user-generated content. Some of our systems enable you to store and share information you or others create. This user-generated content includes variable rate prescriptions, notes, recordings, photographs, PDFs and other file types. We store and share this content only as you direct and to comply with court orders and legal or regulatory requirements.

YOU CONTROL WHO SEES YOUR DATA

Here are your options for controlling your account information when you use John Deere's Data Services and Subscriptions:

SHARING
You may share and disclose data in the John Deere Operations Center and other connected portals and apps. By setting permissions for your account, you control other parties' access and visibility into your data. You also control which John Deere dealers have access to data in your account.[4] Please note that when you share your information with someone other than John Deere, the recipient may decide to copy, use, modify, or distribute it to others, and John Deere has no control over, or responsibility for, any such activities.

MANAGING
You may view, analyze, and manage Production Data, some Machine Data, and some Administrative Data in your account via the John Deere Operations Center and JDLink portals.

EXPORTING
You may download and export Production Data files in the John Deere Operations Center, and you may download some Machine Data from the JDLink portal.

DELETING, UPDATING, AND AMENDING
You may request that we delete, update, or amend Machine Data, Production Data, and Administrative Data in your account, and we will honor your request within five business days. Please note that deleting data may limit our ability to support you and, in some cases, may constitute a termination under the terms of any applicable Data Service and Subscription contracts between you and John Deere, and - subject to any applicable privacy laws - we may retain certain basic Machine or Administrative data for our record keeping purposes. Please review the terms of any such contract for details. [2][3][5]

HOW WE USE YOUR PRODUCTION, MACHINE, AND ADMINISTRATIVE DATA

TO SERVE YOU

We use your data to provide you with contracted services and offerings and to administer your account.

We may share your data with John Deere affiliates and suppliers to provide you with contracted services and offerings and to administer your account. These affiliates and suppliers have committed to protect your data consistent with this statement and all applicable privacy and other laws.[7]

Machine and Administrative Data only – We may share Machine Data and Administrative Data with John Deere dealers so they can support you, unless you explicitly restrict access to specific dealers.[4]

TO LEARN FROM YOU

We may use your data to develop and improve our products and services. For example, analyzing your data may spotlight trends that inform our product support, warranty services, and diagnostic or prognostic activities.

We may combine your data with data from others and include your data in anonymized data sets. These anonymized data sets are proprietary to John Deere. John Deere is free to use and disclose the anonymized data, and John Deere may promote information and services derived from anonymized data. Anonymized data is never traceable back to you or your specific operations.

TO MARKET TO YOU

We may use your data to market products and services to you, targeting offerings to match your activity, interests, and location if you provide any applicable consent. We will communicate with you only according to the preferences you set for your account.[6]

We may share your data with John Deere dealers so they can market products and services to you, targeting offerings to match your activity if you provide any applicable consent.[4,6]

TO COMPLY WITH THE LAW

We share your data as required by applicable laws, including data privacy and consumer protection laws. Our privacy statement is available at www.JohnDeere.com/legal. [3]

We may review and disclose your data to comply with court orders and legal or regulatory requirements; to prevent injury, death, losses, fraud or abuse; to protect John Deere's rights or to defend John Deere in legal proceedings; and to comply with requests from you.

We do not do anything else with your data without your separate consent. If you do not or cannot agree to the data uses described above, then you should not use John Deere Data Services and Subscriptions.

HOW WE PROTECT AND MAINTAIN YOUR DATA

SAFEGUARDING
We have implemented and will maintain standards and procedures designed to prevent misuse of information in your account:

We maintain physical computer and network security.

We educate our employees about the importance of data security and customer service through standard operating procedures and special training programs.

We maintain security standards and procedures to help prevent unauthorized access to information about you, and we update and test our technology to improve the protection of your information.

STORING AND PROCESSING
We store and process data on secure servers in data centers in the United States. In the management of our systems network, we may move data across jurisdictions and may store or process your information outside your home country. By using any John Deere Data Services and Subscriptions you agree that we may process and store your data in hte United States.

DELETING
Please note that John Deere may retain data unless you delete your information as described above. After expiration of any applicable Data Service and Subscription contract, we may delete data at our discretion and subject to requirements in any applicable privacy, consumer protection, or other laws.

NOTES

1. COUNTRIES
This statement applies in the United States of America, Canada, Australia, New Zealand, Argentina, Bolivia, Brazil, Colombia, Paraguay, Uruguay, and South Africa. For other countries see www.JohnDeere.com/legal.

2. JOHN DEERE DATA SERVICES AND SUBCRIPTIONS
The terms of use for the John Deere Data Services and Subscriptions are available at www.JohnDeere.com/agreements.

3. JOHN DEERE PRIVACY STATEMENT
In providing the John Deere Data Services and Subscriptions, we may receive, collect, use, manage, analyze, segment, index, transmit, transfer, store and process personal information which can include names, contact data (telephone number, e-mail, address), and in some cases usage data (including website and mobile app use). Our Privacy Policy is available at www.JohnDeere.com/legal.

4. RESTRICTING DEALER ACCESS TO MACHINE DATA
To remove dealer access to Machine Data from machines in your account you must do both of the following: remove ServiceADVISOR Remote access for each machine from the Terminal Settings tab in the Operations Center and remove access to machine notifications and advisors from the Sharing tab on the JDLink portal.

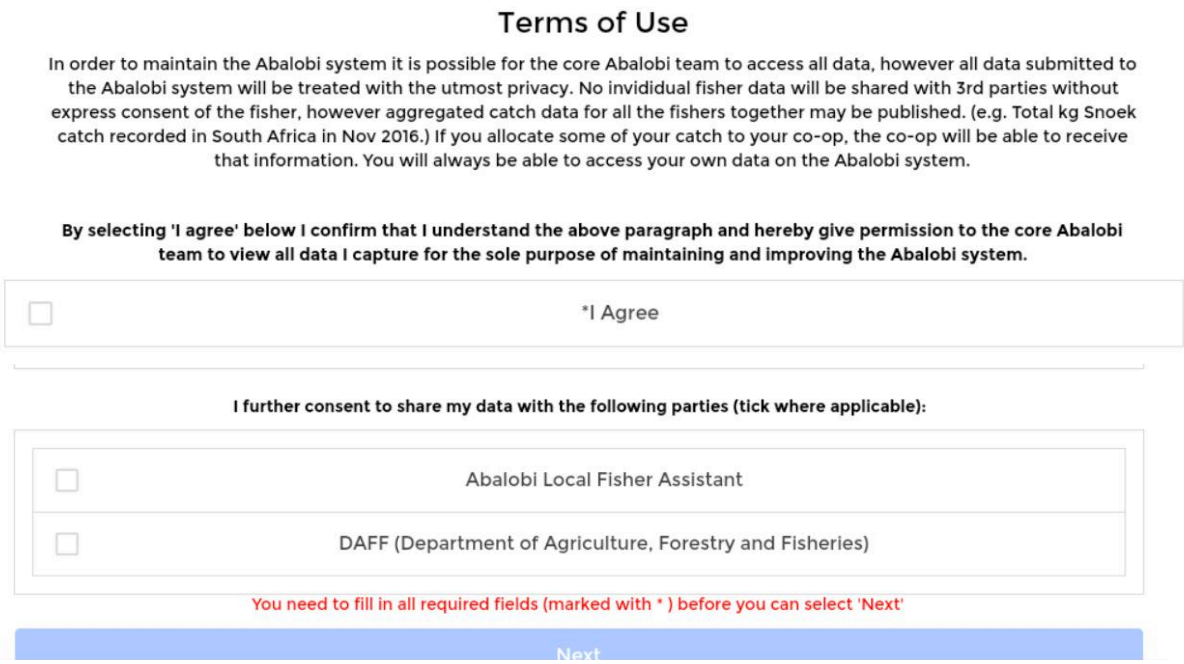
5. DELETING, UPDATING, AMENDING MACHINE DATA, PRODUCTION DATA, AND ADMINISTRATIVE DATA
To request deletion, updates,or amendment of Machine Data, Production Data, or Administrative Data email jdlinksupport@JohnDeere.com, or call 800-251-9928. To understand how deletion may impact or terminate any John Deere Data Services or Subscriptions see www.JohnDeere.com/agreements. To understand your rights with respect to any personal information, see www.JohnDeere.com/legal.

6. MARKETING PREFERENCES Email PrivacyManager@JohnDeere.com for information about your marketing preferences or to change them.

7. ACCESS TO AFFILIATES
All references to "We" in this statement include Deere & Company and its subsidiaries. You may have granted John Deere Financial certain rights to access machine data about your equipment in your financing or lease documents, including the location, maintenance, operation and condition of your equipment. If permitted by your finance or lease agreement, John Deere Financial may continue to access machine data about your equipment during the term of the financing or lease agreement notwithstanding any election you may make. This could include reinstating machine data access if turned-off or otherwise disabled. Please review your finance or lease documents for more information.

Last Updated: May 1, 2017

Appendix B: Abalobi Data Collection Agreement



Terms of Use

In order to maintain the Abalobi system it is possible for the core Abalobi team to access all data, however all data submitted to the Abalobi system will be treated with the utmost privacy. No invididual fisher data will be shared with 3rd parties without express consent of the fisher, however aggregated catch data for all the fishers together may be published. (e.g. Total kg Snoek catch recorded in South Africa in Nov 2016.) If you allocate some of your catch to your co-op, the co-op will be able to receive that information. You will always be able to access your own data on the Abalobi system.

By selecting 'I agree' below I confirm that I understand the above paragraph and hereby give permission to the core Abalobi team to view all data I capture for the sole purpose of maintaining and improving the Abalobi system.

☐ *I Agree

I further consent to share my data with the following parties (tick where applicable):

☐ Abalobi Local Fisher Assistant

☐ DAFF (Department of Agriculture, Forestry and Fisheries)

You need to fill in all required fields (marked with *) before you can select 'Next'

Next

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