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Big Data in food and agriculture

Kelly Bronson[1] and Irena Knezevic[2]

Abstract

Farming is undergoing a digital revolution. Our existing review of current Big Data applications in the agri-food sector has revealed several collection and analytics tools that may have implications for relationships of power between players in the food system (e.g. between farmers and large corporations). For example, Who retains ownership of the data generated by applications like Monsanto Corproation's *Weed I.D.* "app"? Are there privacy implications with the data gathered by John Deere's precision agricultural equipment? Systematically tracing the digital revolution in agriculture, and charting the affordances as well as the limitations of Big Data applied to food and agriculture, should be a broad research goal for Big Data scholarship. Such a goal brings data scholarship into conversation with food studies and it allows for a focus on the material consequences of big data in society.

Keywords

digital revolution in agriculture, farmers, agribusiness, power, material implications of big data

Farming is undergoing a digital revolution. For example, even small-scale farmers are gathering information passively collected by precision agricultural equipment, and many farmers are using information from large datasets and precision analytics to make on-farm decisions. John Deere fits all of its tractors with sensors that stream data about soil and crop conditions and the corporation invites farmers to subscribe (and pay) for access to information that can help them decide, for example, where to plant crops. John Deere tractors are proprietary and the data they collect are not openly accessible to farmers. We can see from this one example that the use of large information sets and the digital tools for collecting, aggregating and analysing them – together referred to as *Big Data* – has the potential to wade in on long-standing relationships between players in food and agriculture (e.g., between farmers and agricultural corporations). Despite a solid body of critical data scholarship, there has been no attention given to Big Data's implications in the realm of food and agriculture. In this commentary, we argue that current understandings of Big Data would benefit from a focus on their material consequences in food and agriculture, and we lay out suggestions as to how a line of inquiry across the fields of data studies and food studies could facilitate such an improved understanding.

Big Data in agriculture?

Arguably, farming has been empirically driven for over a century but the data collected was not digital. Agriculture Canada's family of research centres (circa 1920s) meticulously accounted for wheat yields across farms and weather patterns in order to increase efficiency in production. Big Data is different from this historic information gathering in terms of the volume and the analytical potential embedded in contemporary digital technologies. Big Data proponents promise a level of precision, information storage, processing and analysing that was previously impossible due to technological limitations (see Datafloq, 2015). Compare a notebook wherein a farmer might log information about his or her crop performance with a digital phone 'app' used to predict and direct future production practices. Logging information using the application can be done more efficiently (even by voice recognition) and the volume of information the farmer may access is profound: agricultural management tools provide access to interacting with datasets that stretch way beyond the individual farm. Still, the nature of the distinction between historic farm monitoring and Big Data is an open research question; systematically tracing the digital revolution in agriculture and charting the affordances as

[1]St. Thomas University, Canada
[2]Carleton University, Canada

Corresponding author:
Kelly Bronson, St. Thomas University, 51 Dineen Drive, Fredericton, New Brunswick E3B 5G3, Canada.
Email: kbronson@stu.ca

well as the limitations of Big Data-driven decisions should be a broad research goal for Big Data scholarship in the realm of food and agriculture.

Our existing review of current Big Data applications in the agri-food sector has revealed several Big Data collection and analytics tools that may have implications for relationships of power between players in the North American food system. Under a platform called *Integrated Field Systems* (*IFS*), Monsanto Corporation has a suite of digital tools for collecting and analysing farm data. Farmers are being encouraged to use Monsanto's *IFS* tools to collect information about soil conditions, weed varieties and weather. This information, they are told, will help them minimize risk and streamline decision-making. *IFS* raises questions, however, about the relative benefits of the collection and use of Big Data in farming. In the case of *Weed I.D.*, which helps farmers to identify weeds and map weed pressures in a digital mapping tool, there are likely also benefits to the corporation, namely, promoting proprietary chemicals and identifying new chemical needs and therefore areas of possible investment in research and development. That there are corporate benefits attached to Big Data in agriculture seems evidenced by the recent purchasing habits of Monsanto, which bought the digital tool developer Climate Corporation in 2013. Climate Corp. itself is acquiring 'start-ups' (640 Labs and Solum) who are focused on tools for collecting farm-level information.

The acquisition of these companies by Monsanto suggests that Big Data has implications not just for farmers but also for stakeholders throughout the agri-food system. For instance, food processors are monitoring social media data in an effort to predict consumer sentiment and secure social approval or 'license' (Prno and Slocombe, 2012). Sysmos Corporation has developed an analytics tool called *Heartbeat*, which combs social media for patterns relevant to food marketing trends and consumer interests. The use of social media data to steer corporate priorities is useful for food producers and retailers but it is potentially problematic, not least because social media data is necessarily selective (e.g., only 18.5 million relatively young Canadians use Facebook, Oliviera, 2013).

It may be that the implications of Big Data relate directly to their context of development, namely, for-profit, non-profit or public. The *Agroclimate Impact Reporter* (*AIR*) is an application built by government, specifically Agriculture and Agri-Food Canada's National Agricultural Information Services (NAIS). Climate data from volunteers, farmers and media reporting is gathered using this tool and then the data is anonymized and mapped by NAIS, which maps can then be used by anyone interested in information about current/historical weather conditions municipally, regionally or nationally. The tool is explicitly intended to help producers mitigate weather-related risks but it is also used to support them when they make claims to the Canadian Drought Monitoring and Livestock Tax Deferral program.

Thinking carefully about Big Data in agriculture: New directions in critical data studies?

Thinking carefully about the context of the production and use of Big Data is precisely what critical data studies scholars do when they highlight Big Data as actively framed and interpreted by people, in particular social and technical contexts (Bowker, 2005; Edwards, 2010; Gitelman and Jackson, 2013; Hacking, 1992; Porter, 1995). 'Data [do] not just exist', Lev Manovich explains, they have to be 'generated' (2001: 224). Critical social scientists have suggested that Big Data cannot be treated as a technical accomplishment separable from the social, and in particular from questions of justice and ethics (Busch, 2014; Couldry and Turow, 2014; Crawford et al., 2014; Elmer et al., 2015; Kitchin, 2014). Scholars have, for example, revealed how much 'crowd-sourced' information is primarily benefitting marketers and other elite interests, rather than the crowd (Qualman, 2009). Facebook has been accused and legally tried for the unauthorized collection of user data, from which it is said to profit handsomely (Matlack, 2012).

The critical data studies framework therefore allows for the careful examination of the possible ethical implications that appear to be arising from particular configurations and uses of Big Data in the realm of food and agriculture. Some possible research questions for future work in this area are as follows: Who retains ownership of the data generated by applications like *Weed I.D.*? Are there privacy implications with the data gathered by precision agricultural equipment? Who ought to have access to the data generated by John Deere's precision agricultural equipment? How are corporate scientists and consultants interfacing with data gathered by tools like *Weed I.D.* and are they doing so in service of profit-generating innovations (like new chemicals)?

Exploring the ethical implications of Big Data in food and agriculture not only builds on critical data studies but it also extends food studies scholarship, which has historically focused on the effects of technologies on farmers and food systems (Clapp, 2012; Friedmann, 2009; Friedmann and McMichael, 1987; Koc et al., 2012; McMichael, 2009). Food studies scholarship on the development of genetically modified seeds, for instance, has revealed that these technologies further inequities between farmers and large chemical corporations, not least because of a legal regime that limits farmers' access to the technology (Bronson, 2015).

We predict that particular agricultural systems may be perpetuated not just in the design and use of Big Data—say, for the disproportionate gain of powerful agri-food corporations—but also in the marketing of Big Data technologies. It is obvious that the imagined typical user for John Deere's Big Data analytics is a farmer who unproblematically adopts the newest technologies. In the promissory images of the Farm Forward marketing video (see John Deere, 2012), the farmer is pictured using digital weather apps and living in a completely automated or 'smart' house. The imagery of John Deere's *Farm Forward* marketing campaign is imbued by a long-standing cultural bias towards farming that can be 'rationally managed' as technology-maximizing, profit-oriented businesses – this is called a 'productivist' model for farming (Kneen, 1995). Food studies scholars have revealed productivism as a model of over-production of inexpensive low-nutrient food that has brought great commercial gain to a handful of agri-food conglomerates, but for the rest of the world it has resulted in serious ecological (Moore Lappe, 1971), economic (Lang and Heasman, 2003; Patel, 2007), health (Albritton, 2009) and sociocultural consequences (Esteva, 1996; Kneen, 1995), without notably alleviating hunger and malnutrition in the long term (De Schutter, 2015, para. 6).

The marketing pitches for Big Data applications – along with sensors, meters and other data-generating tools – arguably promise farmers the same thing that tractors and genetically modified seeds were and still are promised to do: 'make the farm pay' (Kneen, 1995). John Deere is said to be 'revolutionizing' farming with Big Data. One description of their Big Data tools suggests that they will enable farmers to 'enhance productivity and increase business efficiency' (Datafloq, 2015). Similarly, Monsanto's *IFS* is described online as integrating 'innovations in seed science, agronomy, data analysis, precision agriculture equipment and service to provide farmers with hybrid matches and a variable rate planting prescription to improve corn yield opportunity' (Monsanto, 2014). These are not new promises; rather, they reflect a long-standing pairing between the good life and the effective application of new technologies to labour (Marx and Roe-Smith, 1994). They arguably also reflect a bias against farming methods that forgo high technologies by implicitly painting them parochial, folksy and backward, which begs for critical reflection on Big Data in agriculture. A key research question here is: In what ways do the images circulating in the promotion of Big Data tools normalize hegemonic farming systems?

While many concerns in the area of Big Data in food and agriculture may have to do with data ownership and the furthering of inequity between food system players, we suspect that the issues are even more complex. While crowdsourcing Big Data tools rely on farmers' knowledge, they do not necessarily invite farmers to shape the context in which that knowledge is collected. Some possible research questions here are: Who has a role in deciding on the context for the data production, storage and use of particular data tools used in food and agriculture? Who decides which kinds of data are to be collected, given the functioning of current big digital collection and analytics tools? Are there farming systems (like holistic farm management systems) whose material realities cannot be captured by applications for collecting quantitative information (Hacking, 1992; Porter, 1995)?

Now is the time for critical data scholarship in food and agriculture

Big Data is poised to reproduce long-standing relationships between food system players – between farmers and corporations, or between organic and conventional farmers – and thus it deserves scholarly attention by both critical data and food studies scholars. Big Data is an important field of study, for 'the era of big data has begun' (boyd and Crawford, 2012: 662). Now is the time for scholarly intervention into Big Data because the consequences of Big Data and its social infrastructure (laws, mores) are not yet fixed. It is a technology's interaction with the social ecology that determines its environmental, social and human consequences (Bijker et al., 2012; Bronson, 2015; Kranzberg, 1986: 545). Once in place, the social system surrounding technologies is notoriously difficult to analyse (Bowker and Star, 1999: 33; Bronson, 2015). As farmers, agricultural corporations and government scientists clamour for access to large datasets in order to drive their decision-making, significant questions are emerging about how these data ought to be understood and managed. Big Data scholarship ought to add to this understanding by asking questions about the context of data shaping and use in agri-food – about how datasets are being constructed and used, by whom they are being used and for whose benefit, and the potential limitations or biases of the datasets under use.

Critically examining Big Data in food and agriculture provides a new site of scholarship for critical data theorists and one that allows for the probing of the links between Big Data and the material aspects of data use. Current enthusiasm for the material effects of social processes – the new materialist turn in social science – has focused less on digital shifts, perhaps because 'things always seem to be disappearing' (Chun, 2011: 11). In the case of food systems, examining the material consequences of digital tools for generating and analysing agricultural information can raise questions of survival if it turns out that Big Data

developments are supporting particular agricultural systems of production, and thus particular farmer livelihoods, at the expense of others.

We have raised questions that carry cultural, political, ecological and material significance. A deliberate and sustained dialogue between data scholars and food scholars on the topic of Big Data in food and agriculture seems a pressing research priority.

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